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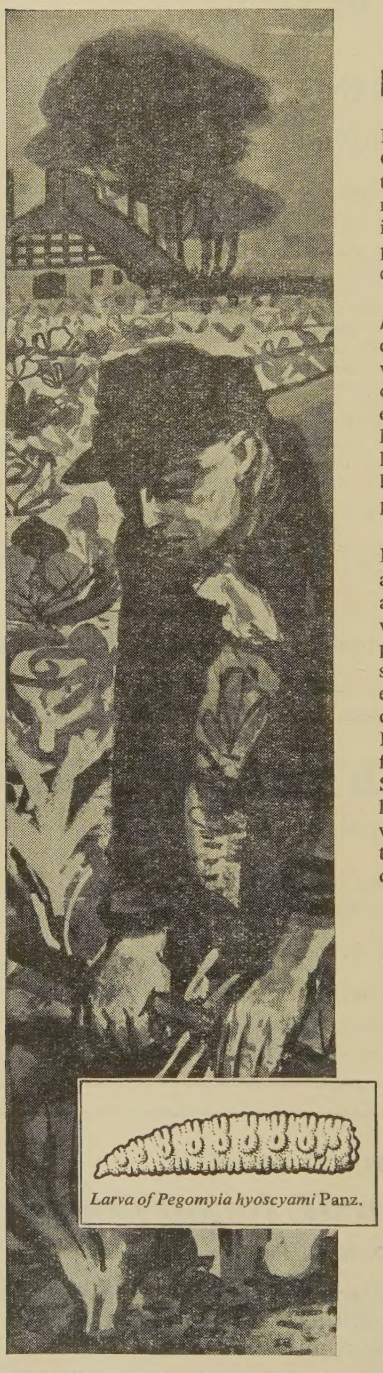

Larva of Pegomyia hyoscyami Panz.

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EDITORIAL

The late Sir Guy A. K. Marshall

Entomologists throughout the world, and particularly in the British Commonwealth, will learn with deep regret of the death of Sir Guy Marshall in London on Wednesday, April 8th, at the age of 87.

He was the " Father " of the present Commonwealth Institute of Entomology and indeed of the Commonwealth Agricultural Bureaux as a whole, for from his small beginning as Secretary of the Colonial Entomological Research Committee (Tropical Africa) in 1909, with a budget of £2,000 per annum, stemmed the Imperial Bureau of Entomology, on which were subsequently modelled the two other Institutes and ten Bureaux, covering practically all branches of agricultural science, that are now included in the organisation, of which the present annual budget is nearly £300,000. The Commonwealth Institute of Entomology will stand as a permanent memorial of his great services to economic entomology.

There were two incidents in Marshall's early life that had far-reaching effects. In 1907 he was appointed Curator of the Sarawak Museum, but was taken seriously ill just before he was due to sail. This apparent disaster left him available for the much more important work that he was to embark on two years later. The second incident was the accident that led to his taking up the study of weevils. He made a collection of beetles in Rhodesia and was returning to England from Salisbury in 1896. At the last minute, it was found that the coach in which he was to travel to Beira could not take a large air-tight box that contained the main part of the collection. This was left behind to be shipped later, but was never heard of again, so he arrived in England with one box containing the remainder of the beetles, which happened to be weevils. These he studied at the British Museum. When he returned to South Africa, he had to remain in Natal on account of the war. Here he spent his time studying the genus *Apion*, having found that he had 90 species in his collection, whereas only ten had previously been described from South Africa.

During his 28 years as Director of the Institute, Marshall found time to carry on his work on weevil classification, despite his numerous other duties. He became the recognised authority on this very large family, especially on the African and Oriental species. Large quantities of insect material are sent to the Institute for determination, including considerable numbers of weevils. Marshall rendered a great service to workers overseas by his prompt handling of this material. Even after he retired in 1942, and until a few weeks before his death, he worked constantly at the Museum and continued to determine all weevils sent to the Institute.

Marshall exercised a profound influence on the development of applied entomology in the Commonwealth, not only through the Institute that he built up so efficiently with the aid of Dr. Sheffield Neave, who was Assistant Director from 1914 to 1942, but also as Adviser to the Colonial Office on entomological matters. But entomologists from overseas will remember him more for his wise and kindly advice, and the stimulation, inspiration and help they received at his hands. He was always ready to see workers from abroad and to discuss their problems with them. He leaves behind a host of friends who will cherish his memory.

Smith (K. M.) & Williams (R. C.). **Insect Viruses and their Structure.**—*Endeavour* **17** no. 65 pp. 12–21, 18 figs. (6 col.), 23 refs. London, 1958

The authors review the various types of viruses that are pathogenic to insects, the ways in which they are spread, and the importance of virus latency, and discuss two viruses recently isolated from larvae of *Tipula paludosa* Mg. Both may occur in the same insect. One is of the nuclear polyhedral type but is unusual in that the polyhedra are not soluble in the usual reagents and elongate in molar sodium hydroxide, the elongation being reversed on transference to water. The other consists of darkly staining particles with no encapsulation or surrounding polyhedral body, and the particles were found by a shadow-casting technique to be icosahedral in shape. This is the first virus for which the geometrical form of the particles has been demonstrated.

Gay (F. J.) & Wetherly (A. H.). **Laboratory Studies of Termite Resistance. I. The anti-termitic Value of some chlorinated Naphthalenes and Phenols.**—*Tech. Pap. Div. Ent. Commonw. sci. ind. Res. Org. Aust.* no. 2, 14 pp., 5 refs. Melbourne, 1958. **II. The Termite Resistance of untreated and treated Hardboards.**—*Op. cit.* no. 3, 13 pp., 1 pl., 2 refs.

Gay (F. J.), Harrow (K. M.) & Wetherly (A. H.). **III. A comparative Study of the anti-termitic Value of Boric Acid, Zinc Chloride, and "Tanalith U".**—*Op. cit.* no. 4, 14 pp., 4 refs.

These three papers contain accounts of laboratory evaluations in Australia of various materials and methods for the protection of timbers and hardboard from attack by termites. The following is based on the authors' summary of the first, which deals with tests of chlorinated naphthalenes and chlorophenols. Di-, tetra- and pentachloronaphthalenes were evaluated by exposing cellulose blocks, treated with graded concentrations of the three compounds, in standard laboratory colonies of *Nasutitermes exitiosus* (Hill) [*cf. R.A.E.*, A **45** 450]. All three materials were shown to possess protective properties and their effectiveness increased with the number of chlorine atoms present in the molecule. The minimum concentrations required to prevent significant attack were 1–2, 1 and less than 0·5 per cent., respectively, by weight. Trichlorophenol, its sodium salt, and pentachlorophenol were tested by pressure impregnation into a susceptible timber (*Sloanea woollsii*) and exposure to *N. exitiosus* and, in the case of pentachlorophenol, *Coptotermes lacteus* (Frogg.) and *C. acinaciformis* (Frogg.). Pentachlorophenol gave adequate protection at 0·54 per cent. (0·2 lb. per cu. ft.) against *N. exitiosus*, but even at 2·16 per cent. did not prevent significant damage by either species of *Coptotermes*. Trichlorophenol and its sodium salt did not give adequate protection at concentrations up to 1·33 per cent. In comparative tests with a mixture of zinc chloride and arsenious oxide (white arsenic) carried out at the same time, a loading of 1·91 per cent. of this mixture was as effective as 0·54 per cent. pentachlorophenol against *N. exitiosus* and definitely superior to 2·16 per cent. pentachlorophenol against both *C. lacteus* and *C. acinaciformis*.

The following is virtually the authors' summary of the second paper. Two possible methods of producing termite-resistant hardboard comprise the use of fibre stock from naturally resistant tree species and the addition of preservative materials to fibre stock of susceptible species. Boards of both types were tested for termite resistance in standard laboratory colonies of *N. exitiosus*, *C. lacteus* and *C. acinaciformis*. Tests of a number of hardboards made from the naturally resistant timber, *Juniperus procera*, indicated

that their termite resistance depended both on the presence of toxic or repellent materials and on the stability of those materials to the processes of manufacure of the hardboards. Hardboards made from fibre stock of susceptible tree species can be made highly resistant to termite attack by the addition of pentachlorophenol or, where there is no objection to the use of arsenicals, by the addition of arsenious oxide. The minimum effective loading of pentachlorophenol was 0·75 per cent. by weight, and of arsenious oxide somewhat less than 0·9 per cent. by weight.

The following is largely based on the authors' summary of the third paper. Tests were made with standard laboratory colonies of *N. exitiosus*, *C. lacteus* and *C. acinaciformis* to determine whether these termites are as susceptible to boric acid, zinc chloride and Tanalith U (a proprietary mixture containing 25 per cent. sodium fluoride, 25 per cent. disodium hydrogen arsenate, 37·5 per cent. sodium chromate and 12·5 per cent. dinitrophenol) as is *Anobium punctatum* (Deg.). They were carried out because several Australian termites, notably species of *Coptotermes*, have become established and injurious in New Zealand, where protective treatment of softwood timber susceptible to *Anobium* is standard practice. All three materials reduced the termite attack on the susceptible timbers, *Podocarpus spicatus* and *Pinus radiata*, provided that the concentrations were adequate. The minimum loadings necessary to protect both timbers against all three species of termites were found to be greater than 1·09 per cent. boric acid, 1·8 per cent. zinc chloride or 0·9 per cent. Tanalith U. These concentrations are considerably higher than those found effective in preventing attack by *Anobium* in New Zealand [*cf.* **38** 139, 261; **40** 28]. The termites showed important differences in their reactions to two of the preservatives, since *C. acinaciformis* had a much higher tolerance of Tanalith U than had *C. lacteus*, and both species of *Coptotermes* were much more susceptible than *N. exitiosus* to boric acid.

MacCuaig (R. D.). **The Toxicity of Insecticides to Adult Locusts.**—*J. Sci. Fd Agric.* **9** no. 6 pp. 330–342, 5 figs., 17 refs. London, 1958.

The tests described [*cf. R.A.E.*, A **45** 137, 387] were carried out mainly with *Schistocerca gregaria* (Forsk.), but repeated when possible with *Locusta migratoria migratorioides* (R. & F.) and *Nomadacris septemfasciata* (Serv.). Laboratory-bred locusts were treated 2–5 weeks after maturing and subsequently kept at temperatures of 24–27°C. [75·2–80·6°F.] and 60–80 per cent. relative humidity. A selected dose of insecticide was applied to the intersegmental region between the first and second abdominal sternites, γ BHC being used in a proprietary oil solution containing 1·5 lb. active compound per gal. and most of the other insecticides in KEB (kerosene extract bottoms), an aromatic petroleum extract of low viscosity. The concentrations were adjusted to make the solutions about as toxic as a solution of DNC in KEB and Iranolin 2241 (20:72:8), with which they were generally compared. The toxicities of γ BHC, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], dieldrin and DNC over a tenfold change in concentration were found to be directly proportional to concentration. The LD50's of DNC, γ BHC and diazinon to *Schistocerca* and of DNC to *Locusta* were 12·8, 9, 4·7 and 12·2 μg. per g. body weight and the corresponding LD99's 23·8, 19·7, 11·9 and 23·7. The LD50's of γ BHC and diazinon to *Locusta* and of DNC, γ BHC and diazinon to *Nomadacris*, obtained from much smaller numbers of insects and of little or no statistical value, were 2–7, 4–7, 10·9, 8·7 and 3·7 μg. per g. and the corresponding LD99's 7–18, 13–20, 17·3, 18·1 and 11·9. Adults of *Schistocerca* that developed from egg-pods collected in East Africa were rather more susceptible to DNC than the average laboratory stock, the LD50 and

LD99 for them being 9·4 and 18·3 μg. per g., respectively. Plotting the dosage necessary for 50 per cent. effective mortality against time showed that whereas final mortalities of the three species were obtained in 2–4 days with diazinon and in 5–10 days with γ BHC, they were obtained within 24 hours with DNC. Females of *Schistocerca* were 1·28–1·52 times as resistant as males to diazinon, but equally susceptible to γ BHC, whereas *Locusta* showed insignificant differences to both γ BHC and diazinon. *Schistocerca* showed no relation between susceptibility and weight in these tests, and no striking correlation between resistance to DNC and either γ BHC or diazinon. The results obtained from mixtures of any two of the three insecticides showed no evidence of synergism, antagonism or similar action, and it is concluded that they act independently.

The other insecticides were tested mainly for contact toxicity, though the results of some tests in which organic phosphorus compounds were applied by injection are included, as the toxicities by this method were not noticeably different, but only aldrin, chlordane, dieldrin, heptachlor, Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], malathion and parathion were considered promising. Toxicity to mammals is closely related to insect toxicity, and of the compounds showing more promise than the DNC solution already commercially used, only diazinon is considered safe for use in the field; Chlorthion, which is equally safe, is more toxic than DNC to *L. m. migratorioides* but less so to *Schistocerca*.

Lubatti (O. F.) & Bunday (G.). **Fumigation of agricultural Products. XVI. Some Aspects of the Fumigation of imported Potatoes in Boxes with Methyl Bromide for the Control of Tuber Moth** *Gnorimoschema operculella* **(Zell.).**—*J. Sci. Fd Agric.* **9** no. 6 pp. 360–366, 5 figs., 10 refs. London, 1958.

Potatoes imported from Mediterranean countries are sometimes infested by *Gnorimoschema operculella* (Zell.), and such consignments are fumigated with methyl bromide on arrival in Britain. Investigations on suitable doses, briefly reported in this part of a series [*cf. R.A.E.*, A **46** 324], showed that all stages of the insect are killed by concentration-time products of 85 mg.-hours per litre at temperatures of 15–25°C. [59–77°F.], and tubers of five varieties were not injured by treatment at 150–200 mg.-hours per litre.

In further tests of the amounts of free methyl bromide remaining in fumigated potatoes [*cf.* **41** 312], five samples were fumigated at concentration-time products of 160 or 200 mg.-hours per litre. One had a residue of 1·3 parts per million after airing for a day, and the remainder residues of 0·05–0·6 p.p.m.; as it is unlikely that potatoes would be cooked within 24 hours of treatment and any traces of methyl bromide would be eliminated during boiling, there appears to be no risk to the consumer. When potatoes that had been fumigated with doses of the order necessary to eliminate *G. operculella* were pulped and tested for fixed bromide, the difference in bromine content between the fumigated and unfumigated samples was less than the difference in natural bromine content between the varieties. The peel from potatoes treated at 250 mg.-hours per litre for 4·5 hours and at 105 mg.-hours for two hours showed increases in bromine content of 0·5 and 0·2 p.p.m., respectively. Palatability tests of untreated potatoes and those fumigated at 270 mg.-hours per litre gave no consistent results.

Some imported potatoes are packed in peat in wooden boxes about 29 × 17 × 8·5 in. in size, lined with thin paper, and the rate of penetration of methyl bromide into such boxes was investigated. A concentration providing 40 mg. per litre in the free space, applied for four hours with gentle circulation at 20°C. [68°F.], followed by aeration for two hours, resulted in a

gradual rise in concentration in the centre of the boxes during fumigation and a considerable post-fumigation effect, with concentration-time products over the whole period of about 145 and 110 mg.-hours per litre in the top and bottom boxes of a pile of three and an intermediate product in the middle box. Extending the period of fumigation to five hours would increase the product by about 30 per cent. There was little difference in the rate of penetration into boxes of potatoes packed with wet or dry peat (70 or 19 per cent. moisture content), but penetration was appreciably greater into a box packed without peat. With a fan drawing the air axially through the centre of the chamber and driving it away round the sides during fumigation, the lowest of a pile of three boxes was penetrated more rapidly than the top one, possibly owing to more rapid air movement; in the central box, packed without peat and situated in a zone of non-directional turbulence between the two opposite streams of air, the concentration rose about as fast as in the free space. The post-fumigation effects were much less marked after rapid stirring, and concentration time products of 160 mg.-hours per litre were obtained with four hours of fumigation and two of aeration. Rapid stirring for one hour only gave similar results, the post-fumigation effect compensating for a slight drop in concentration when the fan was stopped.

PARKIN (E. A.). **A provisional Assessment of Malathion for Stored-product Insect Control.**—*J. Sci. Fd Agric.* **9** no. 6 pp. 370–375, 33 refs. London, 1958.

Malathion is the only organophosphorus compound sufficiently non-toxic to mammals to be used against pests of stored foodstuffs, and its properties and potentialities [*cf. R.A.E.*, A **43** 248; **44** 445; **45** 97] are here summarised. It is compatible with DDT, BHC, chlordane and methoxy-DDT (methoxychlor), but somewhat antagonistic to piperonyl butoxide, and dusts, water-dispersible powders, emulsion concentrates and miscible oils containing up to 5, 25, 60 and 20 per cent. malathion, respectively, and aerosols are possible formulations for use. In Canada, a tolerance of 8 parts malathion per million has been established for small grains, and the admixture of 1 lb. 0·5 per cent. dust with 10 bushels grain for the control of *Cryptolestes* (*Laemophloeus*) *ferrugineus* (Steph.), *Calandra granaria* (L.), *Tribolium confusum* Duv., *Oryzaephilus surinamensis* (L.), *Plodia interpunctella* (Hb.) and *Tyroglyphus* is approved; 4 p.p.m. malathion in wheat of 12 per cent. moisture content remains toxic to *Cryptolestes ferrugineus* for 12 months. It is also permitted to treat empty granaries with 1 gal. 3 per cent. malathion emulsion spray per 1,000 sq. ft.

In a collaborative experiment carried out in Southern Rhodesia and England, no contamination could be detected chemically in samples of maize taken after three months from a stack of bags, each layer of which had been treated during construction with 50 mg. malathion per sq. ft. as a water-dispersible powder. In laboratory tests made in England in 1954–57, a solution of malathion in technical white oil proved highly toxic to adults of *Tribolium castaneum* (Hbst.), *Calandra granaria* and *Ephestia elutella* (Hb.) and slightly less so to larvae of *E. elutella*. The difference between the last two was greater when the solution was applied to jute sacking, and though knockdown of larvae of *Trogoderma granarium* Everts was rapid, death occurred only after 3–4 weeks of continuous exposure. When water-dispersible powders were applied to bricks to give deposits of 40 mg. malathion or lindane [almost pure γ BHC] or 80 mg. DDT per sq. ft., malathion was extremely toxic, γ BHC very toxic and DDT moderately toxic to larvae of *E. elutella* after one day, and the fresh films of malathion were particularly effective in preventing pupation. The malathion and γ BHC deposits gave

poor results after one month and were ineffective after two, whereas DDT remained moderately effective throughout. The alkalinity of the bricks may have been the primary cause of the decline in effectiveness of malathion.

When 0·5 per cent. malathion dusts were mixed with wheat containing 25 per cent. broken grains, more than 8 p.p.m. malathion was needed to prevent reproduction by *C. granaria*, *C. oryzae* (L.) and *Rhizopertha dominica* (F.), and 2 p.p.m. to prevent reproduction by *O. surinamensis*, when talc was the carrier, but less than 4 and 0·5 p.p.m., respectively, with kaolin, possibly owing to better adhesion of the latter to both grain and insects. When 0·5 per cent. malathion on kaolin was mixed with wheat at 25°C. [77°F.] and 70 per cent. relative humidity, concentrations of 0·5, 0·5–1 and 1–2 p.p.m. were required to suppress reproduction by *O. surinamensis*, *Tribolium castaneum* and *Stegobium paniceum* (L.), 8 p.p.m. to suppress reproduction by *R. dominica*, *C. oryzae* and *C. granaria* and 4–8 and more than 8 p.p.m. to suppress that of *Lasioderma sericorne* (F.) and *Ptinus tectus* Boield., respectively. Concentrations of 8 p.p.m. did not prevent larvae of *Trogoderma granarium* that were more than half grown from transforming to adults, but if these were left in the treated grain, 0·5–1 p.p.m. malathion prevented emergence of adults of the next generation, indicating that newly emerged adults, eggs or young larvae must be very susceptible. When *O. surinamensis*, *C. oryzae*, *Tribolium castaneum*, *C. granaria*, *L. sericorne*, *R. dominica*, *S. paniceum* and *P. tectus* were continuously exposed at 25°C. and 70 per cent. relative humidity to malathion deposited on filter paper from a 25 per cent. water-dispersible powder, 50 per cent. mortality was given in three days by deposits of 0·3, 4·4, 5, 5·8, 8, 11, 35 and more than 80 mg. per sq. ft., respectively.

MacLeod (J.). **The Estimation of Numbers of mobile Insects from low-incidence Recapture Data.**—*Trans. R. ent. Soc. Lond.* **110** pt. 13 pp. 363–392, 27 refs. London, 1958.

The following is largely the author's summary. The three major approaches to the analysis of data from multiple releases and recaptures that are applicable to experiments with insects are the method due to Fisher and those due to Jackson [*R.A.E.*, B **28** 140; **39** 97], all of which utilise the results of a series of several successive releases, and Bailey's triple-catch method, which relies on two catches followed by releases and a third catch for recovery only. These methods are described, and their common relation to the Lincoln index, which is also based on the assumption that the proportion of marked individuals in a population sample is the same as that of the total number of marked individuals released to the total population [*cf.* A **46** 249], but which requires only one release and one recapture, is examined. Some difficulties in applying the release-recapture technique to the estimation of numbers of mixed populations of mobile insects are outlined. None of the three analysis methods is suitable for interpreting release-recapture data in cases where the loss-rate of marked insects over a subsequent run of time-intervals cannot be represented by a constant factor, and where the incidence of recaptures is generally low, with many blank days. The weaknesses of the three analysis methods under these circumstances are illustrated by an example of their application to data derived from an experiment with blowflies.

In work on wild blowfly populations, it was found that, because of the difficulty of fully identifying all the species in samples when these have to be released subsequently, a single release was preferable to serial releases, subsequent serial samples being retained for identification. Information on loss-rate, normally supplied by successive releases, was more satisfactorily

obtained by independent experiments, since it did not appear to be a regular rate. Simple methods, evolved for blowfly studies, are described for pooling results from single or serial releases where the recoveries are poor, so as to extract an estimate of numbers. In these, the mortality is estimated from laboratory controls, and the emigration rate beyond the zone of influence of the traps is calculated from independent experiments on the dispersal rate of a concentration of marked flies.

Bradley (J. D.). **A Xyloryctid Moth attacking the Bark of the Rubber Tree in Malaya.**—*Bull. ent. Res.* **50** pt. 1 pp. 9–10, 2 figs. London, 1959.

Lepidopterous larvae found feeding on the outer bark of rubber trees (*Hevea brasiliensis*) on an estate on the west coast of Malaya were identified as *Deloryctis corticivora* Meyr. This Xyloryctid, which is recorded from Malaya for the first time, was described from Java, where the larvae feed on the bark of *Schleichera oleosa* (*trijuga*). Descriptions of the adults of both sexes are given.

Raw (F.). **An Insectary Method for rearing Cacao Mirids,** *Distantiella theobroma* **(Dist.) and** *Sahlbergella singularis* **Hagl.**—*Bull. ent. Res.* **50** pt. 1 pp. 11–12, 1 pl. London, 1959.

A technique for rearing *Distantiella theobroma* (Dist.) and *Sahlbergella singularis* Hagl. in the insectary was devised in the course of work on the chemical control of these Mirids on cacao in Ghana [*cf.* next abstract]. Two or three gravid females were confined in a sleeve cage on a healthy Amelonado cacao seedling grown in a basket until about 20 eggs had been laid on it or further feeding would harm it, after which it was kept in the shade until hatching began. The newly hatched nymphs were collected twice daily from the seedling and transferred to unripe cacao pods suspended in lamp-glass cages closed at the top with mosquito-netting and at the bottom with loosely woven calico and supported in holes in a raised platform. Each pod could support 25–30 first- or second-instar nymphs or about five fifth-instar nymphs or adults for 4–5 days. The adults mated and the females oviposited readily in these cages, but they could not be used for rearing the progeny, since no satisfactory method was found for preventing the pods from wilting before the eggs hatched.

Raw (F.). **Studies on the chemical Control of Cacao Mirids,** *Distantiella theobroma* **(Dist.) and** *Sahlbergella singularis* **Hagl.**—*Bull. ent. Res.* **50** pt. 1 pp. 13–23, 18 refs. London, 1959.

The following is based on the author's summary of this account of laboratory and field investigations on the toxicity, mode of action and persistence of technical DDT and γ BHC applied to cacao in Ghana to control the Mirids, *Distantiella theobroma* (Dist.) and *Sahlbergella singularis* Hagl., some of the results of which have already been noticed from a less detailed source [*cf. R.A.E.*, A **45** 311]. The insecticides were tested as emulsion concentrates at dilutions previously used in field trials [**39** 374; **40** 366; **45** 311; **46** 209], and *Tribolium castaneum* Hbst. served as a test insect in some of the persistence tests, in addition to the Mirids.

In tests of contact and fumigant action, cacao pods were sprayed to drip point with the test insecticides and the deposit was allowed to dry. Mirid nymphs were placed on the pods, and the rate of knockdown and the

mortality after exposure for a test period were recorded. The two species reacted similarly. BHC had a higher toxicity and acted much more rapidly than DDT, and it greatly reduced feeding. Fumigant action was tested alone by spraying cacao leaves to drip point with the test insecticides, allowing the deposit to dry, and then exposing nymphs and adults over disks cut from the leaves. BHC had a powerful but transient fumigant action; adults and fifth- and second-instar nymphs of *D. theobroma* were killed, respectively, after exposure for ½, 4 and 3 hours at 28–30°C. [82·4–86°F.] over leaves treated with 0·25 per cent. γ BHC, and *S. singularis* showed similar results. No fumigant effect was observed after prolonged exposure over leaves treated with 2·5 per cent. DDT.

Persistence was studied by spraying cacao leaves and pods growing under natural conditions and testing the deposit at intervals. Tests with *T. castaneum* showed that when leaves were sprayed to drip point, the toxicity of deposits from 1·25 and 2·5 per cent. DDT fell steadily and was negligible after intervals of three and six weeks, respectively; deposits from 0·25–2 per cent. γ BHC showed negligible toxicity after 2–3 days. Corresponding tests with *D. theobroma* on pods were less consistent but suggested that 2·5 per cent. DDT was still effective against first-instar nymphs after three weeks; 0·25 per cent. γ BHC had a toxic effect for at least several days and depressed feeding greatly for at least a fortnight. It is suggested that BHC may have a local systemic action that persists after the surface deposit becomes ineffective. Of several other insecticides tested against *D. theobroma*, aldrin had high toxicity and a powerful fumigant action and appeared to be the most promising alternative to BHC. It is concluded that BHC would be more effective than DDT for treating mature cacao with low-volume sprays because, in addition to its higher toxicity and quicker action, its fumigant effect would compensate for incompleteness of coverage.

David (W. A. L.) & Gardiner (B. O. C.). **The Action of the Systemic Insecticide Fluoroacetamide on certain Aphids and on *Pieris brassicae* (L.).**—*Bull. ent. Res.* **50** pt. 1 pp. 25–38, 20 refs. London, 1959.

The following is based almost entirely on the authors' summary. Fluoroacetamide, which is readily soluble in water, was tested as a systemic insecticide against *Aphis fabae* Scop. on broad bean (*Vicia faba*) and *Brevicoryne brassicae* (L.), *Myzus persicae* (Sulz.) and the eggs and larvae of *Pieris brassicae* (L.) on young cabbage plants. In most of the tests, sodium fluoroacetate and schradan [*cf. R.A.E.*, A **39** 199; **42** 143] were included for comparison. When infested plants were dipped in solutions, fluoroacetamide was as effective as sodium fluoroacetate against *A. fabae* and *B. brassicae* and both were much superior to schradan. Fluoroacetamide was superior to sodium fluoroacetate in preventing eggs of *P. brassicae* from hatching, and they were about equally effective against the newly hatched larvae. Schradan was already known to have little action on the eggs or larvae [**42** 143]. Neither of the fluorine compounds was very effective against fourth-instar larvae. When the soil or sand was watered with the solutions, fluoroacetamide, like other systemic insecticides, was more readily absorbed by the plants from sand. Against *A. fabae* it was as immediately effective and persistent as sodium fluoroacetate, and both were superior to schradan. Against *B. brassicae* and *M. persicae*, fluoroacetamide was more toxic than sodium fluoroacetate, *M. persicae* being somewhat the more resistant to fluoroacetamide and much the more resistant to sodium fluoroacetate. Slight phytotoxic effects were observed only at the higher dosages. When the solutions were poured on to the soil round the roots of cabbage plants, neither fluorine compound prevented eggs of *P. brassicae* on the

latter from hatching, but the larvae were killed when they began to feed. Applied in this way, fluoroacetamide was more toxic than sodium fluoroacetate to both newly hatched and fourth-instar larvae. When potting compost was treated with solutions of the fluorine compounds and stored in the greenhouse, it was found that both were quickly decomposed at the dosages necessary for systemic action against aphids, but higher dosages were much more persistent. When infested bean plants were kept with their roots in solutions, fluoroacetamide and sodium fluoroacetate were about equally effective, and both were more toxic than schradan to *A. fabae*.

By means of the cut tap-root technique [*cf.* **39** 200], the approximate LD100's for *A. fabae* were shown to be between 0·09 and 0·9 mg. fluoroacetamide, 0·7 mg. sodium fluoroacetate and 50 mg. schradan per kg. fresh plant tissue. When taken up by cabbage leaves through the cut petioles, 5 mg. of the fluorine compounds or 50 mg. schradan per kg. fresh plant tissue gave complete kill of *B. brassicae* in 2–3 days. When larvae of *P. brassicae* were allowed to feed on leaves of cabbage treated in the same way with fluoroacetamide, growth was not prevented until a dose of about 20 mg. per kg. was reached. Sodium fluoroacetate was equally effective, but more than 2,900 mg. schradan per kg. fresh plant tissue was required for the same result. When applied to the older leaves of the plants, the compounds were translocated to the younger ones and killed all three species of aphids feeding on them. Fluoroacetamide was at least as effective as sodium fluoroacetate, and schradan was nearly as effective against *B. brassicae* but much less so against the two other aphids. Even after repeated applications, none of the compounds acting systemically prevented eggs of *P. brassicae* from hatching or had a detectable toxic action on fourth-instar larvae.

Milne (A.). **Biology and Ecology of the Garden Chafer,** *Phyllopertha horticola* **(L.). V. The Flight Season: Sex Proportions.**—*Bull. ent. Res.* **50** pt. 1 pp. 39–52, 6 refs. London, 1959.

This part of a series on the bionomics of *Anomala* (*Phyllopertha*) *horticola* (L.) in Britain [*cf. R.A.E.*, A **47** 46, etc.] contains an account of investigations on the sex ratio, carried out in the Lake District in 1948–52. The following is based on the author's summary of the results. The percentage of females among the pupae immediately prior to emergence ranged from 34·6 to 46·9 [*cf.* **44** 185]. The flight season begins with the emergence of some adult males upon the sward, and, if the weather continues favourable, the first females appear 2–3 days later. Unsuitable weather delayed the advent of females until the sixth day in two seasons. In a homogeneous population, emergence is complete in just under a fortnight, at the end of which the numbers of beetles on the sward are at a peak. Phase 1, in which the beetles swarm over the sward, continues with dwindling numbers for just over a week more and overlaps phase 2, in which the beetles swarm on the bracken [*cf.* **47** 47]. The proportion of females rises throughout phase 1 until the last day or two, when it tends to fall, but generally for most, and sometimes for the whole, of the phase the proportion above ground is far below that in the total population. This is due partly to the delayed emergence of the females but to a greater extent to differences in the activity of the two sexes above ground, the males being fully active every day until the end of phase 1 or the beginning of phase 2 (according to date of emergence), whereas the females are not. No females are present on the bracken until after the first day of phase 2, but their proportion then rises more rapidly and to a higher level than in phase 1 and is close to that for the total population by the middle of phase 2. Since males are by that

time confined to bracken, mass oviposition is more or less complete. During the last week of the season, the proportion of females rises steeply, as a result of their later emergence and longer survival period, which averages a fortnight, whereas the life of the males is rather less. Approximately the first half of adult life is spent in the grass sward area and the second half on the surrounding bracken, hedges or trees. As phase 1 proceeds, the pairing rate of the females decreases, partly because of a change in their mating behaviour as they age, and partly because the proportion of males is falling. The pairing rate is highest, involving an average of 82 and a maximum of 95 per cent. of the available females, in phase 2, when the proportion of males is at its minimum (and corresponds with the true one for the total population), because the beetles are confined to a considerably smaller area on the bracken than on the grass. In weather suitable for flying, the percentage of beetles in the air at a given moment is never more than about 70 and usually less than 50; males tend to fly more than females.

Nye (I. W. B.). **The external Morphology of some of the Dipterous Larvae living in the Gramineae of Britain.**—*Trans. R. ent. Soc. Lond.* **110** pt. 15 pp. 411–487, 109 figs., 55 refs. London, 1958. **The Distribution of Shoot-fly Larvae (Diptera, Acalypterae) within Pasture Grasses and Cereals in England.**—*Bull. ent. Res.* **50** pt. 1 pp. 53–62, 1 graph, 8 refs. London, 1959.

Difficulty in identifying Dipterous larvae that attack cereals has led in the past to damage due to a complex of species being ascribed to a single well-known one, such as *Oscinella frit* (L.) or *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.). In the first of these two papers, the author gives descriptions and figures of the third-instar larvae of some 40 species of Cyclorrhapha, excluding the Agromyzids, found mining in the stems of grasses and cereals in Britain, mainly in southern England, together with a key for their separation and indications of their food-plants and seasonal occurrence. A general account of the external morphology of the third-instar larvae and characters by which larvae in the first and second instars can be distinguished from them are included. Larvae of *O. frit* were found infesting 13 grasses, and larvae that differed morphologically from them and from each other but that gave rise to adults within the limits of variation observed in *O. frit* were found, respectively, in *Arrhenatherum elatius* and *Anthoxanthum odoratum*; those in the latter grass also attacked *Alopecurus pratensis*, one of the food-plants of typical *O. frit*, and might fit the very brief description of *O. alopecuri* Mesn. provided in a key of Balachowsky & Mesnil [*R.A.E.*, A **24** 106]. No morphological differences were found between larvae of *O. frit* from the tillers and panicles of oats.

In the second paper, an account is given of quantitative investigations in 1953–55 on the larvae in grasses, carried out by sampling pure grass clumps and a mixed pasture in October–March, when the larvae were hibernating in the third instar. The same food-plant preferences were broadly maintained in both types of sample, and laboratory experiments and the field observations indicated that they are due to the selectivity of the ovipositing females rather than to the dietary requirements of the larvae, which are able to develop on most grasses and cereals. The relative abundance of the larvae of some 17 species found in the 16 different grasses examined is shown in a table, which also indicates the degree of specificity of each species. *O. frit* was found in 11 of the common grasses, and preliminary experiments showed that the females also oviposit and the larvae develop on barley, oats, rye, wheat and maize. A consideration of the number of tillers produced per unit area by the grasses and by wheat and spring oats indicated that larval

populations sufficient for 100 per cent. infestation of cereals would be normal and unnoticeable on grasses in adjacent headlands and pastures. The distribution of the larvae among the grasses is influenced by horizontal migration from tiller to tiller and by vertical migration from ploughed-in grasses to cereals sown above them [*cf.* **9** 205]. Experiments with larvae of *O. frit* showed that migration is mainly limited to autumn and spring, when soil temperatures are above the thermal threshold of activity (45°F.).

Briggs (J. B.). **Three new Strains of** *Amphorophora rubi* **(Kalt.) on cultivated Raspberries in England.**—*Bull. ent. Res.* **50** pt. 1 pp. 81–87, 8 refs. London, 1959.

Previous work on strains of *Amphorophora rubi* (Kalt.), demonstrating the existence of one strain on dewberry (*Rubus caesius*) and of two on raspberry (*R. idaeus*), of which the European one does and the North American one does not breed on the variety Lloyd George [*cf. R.A.E.*, A **45** 418, 484], is discussed, and evidence, based on work in south-eastern England connected with breeding raspberries for resistance to *A. rubi*, is presented, showing that the European form itself includes three strains. The aphid stocks used included one reared from aphids collected from various raspberry varieties and another from the variety Malling Promise, which gave similar and consistent results when tested on a wide range of varieties and unnamed seedlings and together are designated strain 1; this strain did not breed on Chief (a commercial American variety) or Baumforth A or their derivatives. Another stock originated from aphids on the variety Malling Landmark (a hybrid of Baumforth A), and in tests bred on Baumforth A and others of its derivatives, but not on a derivative of Chief (87/6), and is designated strain 2. A fourth stock, designated strain 3, was derived from a female included among field-collected aphids that readily colonised derivatives of 87/6 that were resistant to strain 1; this strain colonised 87/6 (though not fully) and such of its derivatives as were tested. When all the strains were tested on Malling Promise, Malling Landmark and 87/6 under uniform conditions, all colonised Malling Promise, strain 2 colonised Malling Landmark only and strain 3 colonised 87/6, though not readily. Examination of apterae provided no evidence that the strains were of specific or subspecific status. Strain 3 appeared to be abundant at East Malling in 1955, when derivatives of 87/6 shown in previous and subsequent insectary tests to be resistant to strain 1 quickly became infested in the field, but its distribution is otherwise not known, since the varieties susceptible to it are not cultivated in Britain. Strain 2 was found in areas in Suffolk and Kent where Malling Landmark is still grown, but appeared to be restricted to small foci, even where opportunities for spread existed during the summer. All three strains bred on the variety Lloyd George and failed to breed on *R. caesius*, so that they are evidently distinct from the North American strain and the strain that attacks *R. caesius*. They also failed to breed on the John Innes blackberry (*R. rusticanus inermis* × *R. thyrsiger*). Since they readily colonised a raspberry variety that was previously shown to be resistant to *A. rubi* in Holland [*cf.* **40** 279], a fourth distinct strain appears to be present in that country.

Bünzli (G. H.) & Büttiker (W. W.). **Fungous Diseases of Lamellicorn Larvae in Southern Rhodesia.**—*Bull. ent. Res.* **50** pt. 1 pp. 89–96, 36 refs. London, 1959.

During studies on the bionomics of Lamellicorn larvae in tobacco fields in Southern Rhodesia, larvae of *Anomala exitialis* Pér. and *Schizonycha profuga*

Pér. in a small area in one field were found in December 1950 and January–March 1952 to be affected by fungus disease. This interfered with moulting in *Schizonycha*, and in consequence the third-instar larvae, pupae and adults were often malformed and readily succumbed to secondary infections. Dead larvae were first found in the field towards the end of February, and the percentages of diseased and (in brackets) dead larvae were 78 (4·6) on 1st March and 71 (28·75) on 15th March; some larvae apparently healthy on these two dates subsequently developed symptoms, and the final disease percentages were 95 and 82, respectively. *Torrubiella* sp. was the prevalent fungus concerned. *Beauveria bassiana* occurred on five of 23 dead larvae collected on 15th March and stored in separate tubes, but was of only secondary importance in the field. A few apparently healthy larvae of *Anomala* collected during February and March were infected by *Metarrhizium anisopliae*. No disease was found among a light infestation of larvae including *A. exitialis* and *S. profuga* in a fallow field adjoining the infected area on 30th January 1952, but 3 per cent. of the larvae of these two species were affected by 28th March, and similar light attacks probably occur throughout the tobacco-growing districts towards the end of the growing season. Analyses of soil from areas in which the disease did and did not occur showed that the humus and nitrogen contents were higher in the former; such conditions favour both larvae and fungi. In view of the semi-arid climate and the apparent ubiquitousness, but only occasional efficacy, of the fungi, they are considered to offer little promise for use in biological control.

Brown (E. S.). **Immature Nutfall of Coconuts in the Solomon Islands. I. Distribution of Nutfall in Relation to that of *Amblypelta* and of certain Species of Ants.**—*Bull. ent. Res.* **50** pt. 1 pp. 97–133, 2 pls., 1 graph, 1 map, 8 refs. London, 1959.

The following is based on the author's summary. In the British Solomon Islands, the incidence of the immature nutfall of coconuts caused by *Amblypelta* spp. depends on the distribution of the species concerned, which determines on what islands nutfall occurs, and on that of certain species of ants [*cf. R.A.E.*, A **40** 208; **44** 466], which affects the local distribution of nutfall on those islands. *A. cocophaga* China is the most important species causing nutfall; *A. cristobalensis* Brown [**46** 412] and to a less extent *A. costalis* Van D. also frequent the palm and cause nutfall, but not on a serious scale; *A. gallegonis* Lever rarely, if ever, attacks coconut. With regard to the ants, the author accepts the current view that *Oecophylla smaragdina* (F.) protects coconuts against *Amblypelta*, and that *Pheidole megacephala* (F.) and *Iridomyrmex myrmecodiae* Emery give little or no protection, but presents evidence showing that *Iridomyrmex* gives some protection against *A. cristobalensis* on San Cristobal. Considerable evidence from various sources shows that, at least on Guadalcanal and Malaita, a fourth species, *Anoplolepis longipes* (Jerd.), the relation of which to nutfall was hitherto in doubt, affords nearly, if not quite, as much protection against *A. cocophaga* as does *Oecophylla*.

A method based on crop estimation is described and used to give some indication of the losses due to nutfall in the European plantations surveyed; its accuracy is discussed in an appendix. Varying numbers of nuts survive to maturity in areas in which premature fall due to *Amblypelta* is prevalent, depending on the intensity of attack. In addition to the loss caused by the failure of nuts to survive to maturity, *Amblypelta* attack causes further losses by reducing the amount of copra obtainable from surviving nuts and by rendering plantations in which attack is severe unprofitable to work, so that they represent a total loss, although a proportion of the nuts survives attack.

An attempt is made to evaluate and compare the fractions of the crop lost on some of the principal islands, but it was found impossible to give an even approximately accurate figure for the losses due to nutfall in the islands as a whole, because essential data were often lacking, and shortage of time precluded sufficiently detailed surveys of many plantations.

The numerous ants recorded from the plantations during the work are listed in a second appendix.

VANDERPLANK (F. L.). **Studies on the Coconut Pest, *Pseudotheraptus wayi* Brown (Coreidae), in Zanzibar. II. Some Data on the Yields of Coconuts in Relation to Damage caused by the Insect.**—*Bull. ent. Res.* **50** pt. 1 pp. 135–149, 7 refs. London, 1959. **III. A selective residual insecticidal Formulation and its Effects on the Ecology of the Insect.**—*T. c.* pp. 151–164, 12 refs.

These two papers form parts of a series on the losses caused by *Pseudotheraptus wayi* Brown to coconuts in Zanzibar [*cf. R.A.E.*, A **46** 413]. The following is based almost entirely on the author's summary of the first. The yields obtained from a number of coconut plantations over the years 1944–55, together with information for each plantation on the location, the soil, the number, height and condition of the palms and the ant species present [*cf.* **42** 42], are given in tables. The variation in yield from year to year in any one group of plantations was not large, and over all those considered did not exceed 25·8 per cent. of the 12-year mean. In the plantations on poorer soils, in which the predominant ant was *Anoplolepis longipes* (Jerd.) or *A. custodiens* (F.Sm.), the vidaka damage rate (V.D.R.) [**46** 414] during 1955 varied from 60 to 80. The plantations on better soils are occupied predominantly by a complex of *Oecophylla longinoda* (Latr.) and *Pheidole punctulata* Mayr, and the V.D.R. determined on a part of these in 1955–56 varied from about 41 to 55, with a mean of 47·1. The mean value of the V.D.R. calculated from 200 localities taken at random in Zanzibar during June–August 1955 was 60·6. By taking a value of 50 as a conservative estimate of the V.D.R. for the whole island and inserting this in the regression equation $Y = a + bX$ relating yield (Y) with V.D.R. (X), derived in the first paper of the series, together with the average values of the constants a and b obtained therein [**46** 415], it is shown that about two-thirds of the potential crop of coconuts is lost as a result of damage by *Pseudotheraptus*. Comparison of the yields from palms occupied by *Oecophylla* in two of the plantations on better soil with those of the whole of the respective plantations suggests that about one-half of the potential crop is being lost. From a consideration of the lower and upper estimates of the amount of crop lost and of the value of what remains, the minimum and maximum financial losses due to *P. wayi* in Zanzibar are estimated as £500,000 and £2 million, respectively.

The following is virtually the author's summary of the second paper. An undesirable effect of using a dust containing 0·4 per cent. γ BHC (lindane) for the control of *P. wayi* on coconut [*cf.* **42** 41] is the eradication of *O. longinoda*, and, in the search for a more suitable preparation, formulations that contained DDT with synthetic resins to prevent its absorption through the treated surface of the palm were tested. One such formulation, prepared by dissolving 23·5 lb. of a proprietary coumarone indene resin and then 235 lb. 80 per cent. p,p′DDT in a mixture of 100 gal. power kerosene and 100 gal. diesolene, heated to 40–45°C. [104–113°F.], is here termed 10 DRDK, and its properties are described.

When 10 DRDK was applied by pneumatic hand-sprayers to the centres of palm crowns, small species of ants (*Pheidole* spp., *Crematogaster* spp.

and *Paratrechina longicornis* (Latr.)) and *A. longipes* were eradicated from such sites, whereas *O. longinoda* increased in numbers and other large species (including *Camponotus* spp. and *Polyrhachis* spp.) were unaffected. Although 10 DRDK was lethal to all species when applied as an aerosol in the laboratory, the residual deposit from it killed only the smaller species, apparently because their bodies make contact with the DDT crystals, whereas those of the larger species (except *A. longipes*) are held clear. Under Zanzibar conditions, this deposit, which is at first gummy, gives rise within 2–3 weeks, or following mechanical disturbance, to needle-like crystals of DDT, 10–120μ long × 2–10μ wide, projecting from the sprayed surface and forming clumps up to 1·5 mm. high.

In field tests, paper bands dipped in 10 DRDK and attached round palm trunks prevented the passage of *A. longipes* for six and of *Pheidole* for nine months, despite heavy rain; the larger species of ants were unaffected. The deposits on sample bands selected each week at random showed great variability but fell from 392–478 μg. DDT per sq. cm. initially to 92–176 μg. after 31 weeks. In concurrent tests of similar bands exposed in the laboratory, the deposit fell only to 282 μg. per sq. cm. over approximately the same period.

In tests of 10 DRDK applied topically to the dorsum of *Pseudotheraptus*, complete mortality of adults was obtained within 48 hours with droplets 85μ in diameter (containing 0·31 μg. DDT), and the size required diminished progressively the earlier the stage treated. When individuals of *P. wayi* were allowed to walk for one minute on glass plates bearing known deposits from 10 DRDK, complete mortality of all stages, from second-instar nymphs to adults, followed within 24 hours of exposure to 2·7 mg. DDT per sq. ft., but not to 1·6 mg., except in the case of recently moulted adults or fifth- or fourth-instar nymphs.

Two experimental areas totalling some 1,000 palms, of which 10 per cent. had *Oecophylla* nesting in them in October 1952, were sprayed with a commercial formulation containing DDT between November 1952 and June 1953, and the percentage fell to 2·5; the areas were then treated with 10 DRDK by hand-sprayer until January 1954 and by machine for the rest of 1954. The percentage of palms having *Oecophylla* in October 1953, October 1954 and February 1955 increased to 7, 15 and 38, respectively. In a control area one mile away, the percentage rose from 23·5 to 36 over the same period. In a third area, 12 applications of 10 DRDK totalling 10 gal. per acre were made by machine during 1953, 12 totalling 33 gal. in 1954 and nine totalling 30 gal. in 1955, and the percentage of palms colonised by *Oecophylla* rose from 0 to 21·7 in 1953, to 26·1 by March 1955 and to 30 by April 1956, while the percentage colonised by *A. longipes* fell over the same period from 90 to 1·5. In the control areas, *A. longipes* remained dominant and *Oecophylla* did not become established.

The addition of γ BHC to 10 DRDK to give concentrations of 0·1–1 per cent. adversely affected the selective properties of the formulation, and although the highest concentration gave a good kill of *P. wayi* and other insects, apart from Coccids, which increased considerably, it reduced *Oecophylla* to a greater extent than it did other species of ants. No advantages were obtained by the addition of dieldrin, endrin, pyrethrins or rotenone.

Swaine (G.). **A preliminary Note on *Helopeltis* spp. damaging Cashew in Tanganyika Territory.**—*Bull. ent. Res.* **50** pt. 1 pp. 171–181, 1 pl., 2 graphs, 6 refs. London, 1959.

Cashew (*Anacardium occidentale*) is becoming an increasingly important crop in the coastal region of Tanganyika, but is damaged there by *Helopeltis*

anacardii Miller [*cf. R.A.E.*, A **43** 10] and another Mirid tentatively identified as *H. bergrothi* Reut. Damage by *Helopeltis* was first recorded on cashew in Tanganyika in September 1945; E. O. Pearson has records of large populations of a species believed to be *H. schoutedeni* Reut. attacking cashew in Mozambique in June 1945 and an unidentified species on cashew in the Sudan. Both species present in Tanganyika occurred in collections made from cashew in Zanzibar in August 1955.

Observations in Tanganyika in June–July 1955 showed that complete development of *H. anacardii* averaged 35·9 days and that of the other species 39·2. The adults survived for about 17 days. Eggs were laid mostly at the tips of the vegetative and flowering shoots, but sometimes in the main veins of newly opened leaves. The first-instar nymphs fed gregariously on the lower surfaces of the young leaves, but nymphs in the fourth and fifth instars fed mainly on the stems. Feeding by the nymphs or adults caused distortion of the leaves, destruction of the unopened terminal buds (resulting in proliferation of side shoots and malformation of the tree), die-back of the shoots, shrivelling of the young nuts and stunting of older ones, and shrivelling or drying out of the cashew apple and premature cracking of the outer skin, facilitating the entry of disease organisms and secondary insects such as *Carpophilus* and *Drosophila* spp. Damage was less marked on mature trees (8–14 years old) than on trees up to four years old, in which it may result in malformation, stunting and delay in the onset of cropping. Both Mirids were scarce in May and June, but their numbers increased throughout the main growing period of the trees and they were common from July until October or November, when the crop matures; they were also common during December–April on young trees, which make considerable vegetative growth during that period. Dusting young trees with 0·5 per cent. γ BHC or 5 per cent. DDT up to 14 times during the growing season of 1955 resulted in increased yields, but the increases were not economic, mainly because the trees were coming into bearing for the first time, though cross-infestation from untreated plots may have reduced the effectiveness of the treatments. In 1956 and 1957, 3–4 applications of the BHC dust by means of knapsack-type power dusting equipment to a mature tree and to trees 2–4 years old at 15-day intervals before the flowering of the main crop gave promise of successful control.

Hanna (A. D.), Heatherington (W.), Mapother (H. R.) & Wickens (R.). **An Investigation into the possible Control of the Mealybug Vectors of Cacao Swollen-shoot Virus by Trunk Implantation with Dimefox.**— *Bull. ent. Res.* **50** pt. 1 pp. 209–225, 9 refs. London, 1959.

The following is substantially the authors' summary. Preliminary experiments having shown that dimefox (bis(dimethylamino) fluorophosphine oxide) placed in holes drilled at ground-level in cacao trees gave encouraging results in controlling *Pseudococcus njalensis* Laing, *Planococcus citri* (Risso) and *Ferrisiana virgata* (Ckll.), the most important of the mealybugs that transmit swollen-shoot virus [*R.A.E.*, A **44** 7], two further experiments to investigate the technique and determine the optimum dosage were performed in Ghana in April–June and September–November 1953, respectively. A randomised-block lay-out was used, with four replicates (each comprising a plot of seven trees) of each treatment at Tafo and, in the first experiment, another two at Bunso. The first experiment disclosed no significant difference in effect when the implantation holes were spaced with their centres four or two inches apart and the wider spacing alone was used in the second experiment. The dosage levels of dimefox, based on the weight of the aerial part of the tree estimated from the girth-weight ratio [*cf.* **44** 6], were

75, 150, 225 and 300 parts per million w/w in each experiment, the lowest representing about one-twelfth of the soil-application rate, and also 375 p.p.m. in the second experiment. The results were assessed in terms of the total number of mealybugs of all three species counted on the various parts of the trees, which were felled and examined six weeks after treatment; counts made on a duplicate set of trees in the second experiment that were felled at nine weeks were significantly greater.

Statistical analyses of the logarithmic transformations of the population figures obtained at six weeks showed the regression of population on dosage to be a curve of quadratic form. There was thus a limit to the response obtained, the minimum total combined populations of adults and nymphs being achieved at a dose rate of 218 p.p.m. in the first experiment and 317 p.p.m. in the second. In the former, the minimum value of the average population of mealybugs per tree was below that required for efficient control (one per tree), but the variability of the response was such that the population on 35 per cent. of trees so treated would have been above that level; in the latter, the minimum average value attainable was only slightly less than one, and the population on nearly half the trees would consequently have exceeded the level for effective control. Analysis of the combined results from those replications of each experiment that were sited at Tafo showed that a given dosage rate appeared only about half as effective, in terms of the residual population (expressed logarithmically), in October–November as in April–May, but concurrent records from untreated control trees suggest that this may partly have been because populations were falling naturally at the earlier date. Slight leaf-shedding occurred in some of the treated trees.

Thresh (J. M.). **The Spread of Virus Disease in Cacao.**—*Tech. Bull. W. Afr. Cocoa Res. Inst.* no. 5, 36 pp., frontis., 3 figs., 3½ pp. refs. London, 1958.

The following is almost entirely the author's summary of this review of work, principally in Ghana, Nigeria and Trinidad, on the spread of the swollen-shoot disease of cacao [*cf.* also *R.A.E.*, A **47** 99]. The virus is disseminated by mealybugs, of which *Pseudococcus njalensis* Laing predominates in Ghana [*cf.* **39** 303], *Planococcus citri* (Risso) in Trinidad [**42** 377], and different species in different areas and seasons in Nigeria [**45** 312], and these initiate new outbreaks by moving from the various sources of infection to healthy trees [*cf.* **46** 417]. Spread usually takes place within the crop, both from trees and also from pods when these are harvested or distributed to provide seed. At least in West Africa, indigenous forest trees are alternative sources of infection, from which virus may have spread into cacao [*cf.* **47** 148, etc.]. However, they are now relatively unimportant in most localities, as virus is widespread and readily available in the introduced crop.

Observations on the uninterrupted spread of naturally occurring outbreaks in West Africa and Trinidad show that most new infections appear close to trees already showing symptoms, and this is primarily due to the movement of immature mealybugs for short distances through the canopy [*cf.* **45** 308; **46** 417]. Immature mealybugs, particularly first-instar nymphs, are also dispersed by wind currents [*cf.* **40** 185; **45** 309], and this accounts for the relatively infrequent discontinuous spread over greater distances. Thus, most new outbreaks are grouped round existing ones, and their incidence decreases with increasing distance from them.

The rate of virus spread depends basically on the number of mealybugs moving from infected to healthy trees, and this varies with seasonal and

other factors affecting the size, composition, distribution and behaviour of the vector population [*cf.* **40** 185; **45** 317; **46** 417]. However, the proportion of active mealybugs that are viruliferous depends on the time spent on the infected plant [*cf.* **45** 308], the available virus [*cf.* **39** 47] and the rapidity with which they reach healthy trees [*cf.* **39** 304; **46** 417, etc.]. The proportion that actually transmits varies with the spacing [*cf.* **46** 417], age and condition of the trees and on their susceptibility to infection [*cf.* **44** 48, etc.].

Monthly observations on spread in Nigeria showed a correlation between the annual number of new infections and the number of apparently healthy trees that had been in contact with infected ones at the end of the previous year. Thus the annual number of new infections appearing round an outbreak tends to increase to a maximum and then declines as most of the trees become infected. Most of the infected trees in large outbreaks are not in contact with healthy ones and support relatively few mealybugs as they deteriorate in condition [*cf.* **39** 369; **44** 187]. By comparison, the ratio of infected trees to healthy ones in contact with them is low round small outbreaks, which tend to spread at a relatively more rapid rate than large ones.

Cacao swollen-shoot virus spreads slowly as compared with other plant viruses and can be controlled by eradication of infected trees [*cf.* **47** 99], the efficiency of which depends upon the amount and extent of spread from latent and missed infections before these are eventually found and destroyed. The infected trees that are missed by the survey parties are relatively few round small outbreaks and occur over a limited distance as compared with their distribution round large ones. In consequence, small outbreaks are more readily controlled than large ones, and cutting-out treatments should vary with outbreak size. The present eradication measures may eventually be made more effective by using insecticides. These are now being applied to apparently healthy trees round treated outbreaks in an attempt to prevent spread from missed and latent infections.

Chant (S. R.). **Studies on the Transmission of Cassava Mosaic Virus by *Bemisia* spp. (Aleyrodidae).**—*Ann. appl. Biol.* **46** no. 2 pp. 210–215, 12 refs. London, 1958.

Crops of cassava (*Manihot esculenta* (*utilissima*)) at Ibadan, Nigeria, are all infected with the virus of cassava mosaic, which is transmitted by whiteflies of the genus *Bemisia* that were in the past diversely identified but have since been found to be *B. tabaci* (Gennadius) [*cf. R.A.E.*, A **46** 136]. Little was known of the relations of this virus to its vector [*cf.* **27** 94, 153], and experiments were therefore carried out. The following is based largely on the author's summary of the results.

Adult whiteflies that had originated from a mixed culture obtained from cassava in the field needed to feed for at least four hours on the young leaves of an infected plant before they acquired the virus. Whiteflies that acquired virus in 4–6 hours required another four hours to become viruliferous. Once viruliferous, they could infect healthy plants in a feeding period of 15 minutes, but longer periods gave more infections. Adults remained infective for more than 48 hours after ending their infection feed. Cassava fed upon by only one viruliferous adult sometimes became infected. In a field trial, 28 of 520 healthy cassava seedlings in small plots surrounded by infected plants developed symptoms within four weeks after transplanting, though the average observed daily incidence of adult whiteflies was only one per five plants. The virus-vector relations of cassava mosaic resemble those of cotton leaf-curl virus [*cf.* **19** 709], but the first was not transmitted by the whiteflies to cotton or the second to cassava.

Hussey (N. W.) & Parr (W. J.). **A genetic Study of the Colour Forms found in Populations of the Greenhouse Red Spider Mite,** *Tetranychus urticae* **Koch.**—*Ann. appl. Biol.* **46** no. 2 pp. 216–220, 2 figs., 11 refs. London, 1958.

The following is based largely on the authors' summary. Two forms of *Tetranychus telarius* (L.) (*urticae* Koch) occur on plants under glass in Britain, one with green summer females and the other with reddish-brown females. The latter form, which is usually associated with carnations, could not be induced to enter diapause, unlike the former, which overwinters in this state. Cross-breeding experiments are described, from which it is concluded that these forms are subgenerically distinct, but that hybrids of low fertility can occur. The reddish colour of the female hybrids is incompletely dominant over the green, and under some conditions they are indistinguishable from the reddish-brown form. The absence of diapause in the reddish-brown form indicates that it is distinct from *T. cinnabarinus* (Boisd.), as recognised by Boudreaux [*R.A.E.*, A **46** 261]. Considerable differences in susceptibility to acaricides have been reported among strains of *T. telarius* [*cf.* **39** 313; **44** 57; **46** 57]. In view of the difficulty experienced in separating the reddish-brown and hybrid forms in natural populations, only mites from pure strains of known genetic constitution, derived from single females and reared through several generations, should be used in tests.

Lea (A.). **Recent Outbreaks of the Brown Locust,** *Locustana pardalina* **(Walk.), with special Reference to the Influence of Rainfall.**—*J. ent. Soc. S. Afr.* **21** no. 1 pp. 162–213, 12 graphs, 2 maps, 1 fldg. table, 11 refs. Pretoria, 1958.

The following is based on the author's summary and conclusions. A general account is given of the outbreaks of *Locustana pardalina* (Wlk.) that occurred in South Africa in 1941–55, from which it appears that, as a result of the continual use of insecticides, principally sprays and baits containing BHC, against incipient swarms, plague conditions developed rather slowly. Once infestation was widespread, however, control measures could not prevent a rather regular intensification of locust activity, which culminated in the peak infestation of 1950–51. Factors other than human intervention were presumably partly responsible for the rather sudden collapse in 1954–55. The frequency of control operations against hoppers in the various magisterial districts over a period of 25 years is shown on a map. The areas with high frequencies correspond closely with the outbreak areas of Faure & Marais [*R.A.E.*, A **25** 632; **26** 684], and a line drawn round districts in which control operations were carried out in nine or more years of the 25 encloses an area of about 100,000 sq. miles that is now generally accepted as comprising the outbreak region of *L. pardalina*. It has a sharply defined boundary on the east, but not on the drier, western side.

The relation between rainfall and increase or decrease in locust activity [*cf.* **30** 402, etc.] was studied in 12 districts representative of the recognised outbreak region. Increase or decrease of activity in any given season or district was measured in terms of the money spent on labour and transport in control operations in relation to that spent in the same area in the previous season. District rainfall was taken as the mean of the records of four or five rainfall stations considered in half-seasons. The total rainfall recorded between July and December was regarded as early summer rainfall and that for January–June as late summer rainfall. Significant locust increases and decreases were correlated graphically and statistically with the corresponding rainfall characteristics over the 12 districts for the period of

14 years under review. The main conclusions were that locust fluctuations are related to the amount of early summer rainfall but not to rainfall in the later summer or the season as a whole; that fluctuations are more closely associated with rainfall in the season before the increase or decrease was registered than with current rainfall; and that an increase most often follows a season in which the early summer rainfall is low, whereas a decrease most often follows one in which the early summer rainfall is higher than the modal rainfall for the region as a whole. A consideration of the data for outbreaks in 1913–41 [*cf.* **27** 93] indicated that increases and decreases during that period generally followed the same pattern as that described for more recent outbreaks in that seasons of significant decrease were almost always preceded by seasons of which the early summer was wetter than usual. The correlation between locust increases and preceding rainfall was less clearly defined.

A dry early summer may be looked upon either as delaying the swarming process or as a preparatory period favouring the increase of scattered solitary locusts that represent the parent populations from which swarms eventually arise and indirectly favouring survival by checking natural enemies such as birds, predacious insects and disease organisms.

Dürr (H. J. R.), Joubert (C. J.) & Walters (S. S.). **Die uitwerking van grondtoedienings van aldrin, dieldrin en chlordaan op besmettings van die Argentynse mier** (*Iridomyrmex humilis*) **oor 'n periode van vier jaar.** [The Effect of Application to the Soil of Aldrin, Dieldrin and Chlordane on Infestations of the Argentine Ant (*I. humilis*) during a Period of Four Years.]—*S. Afr. J. agric. Sci.* **1** no. 1 pp. 75–82, 3 refs. Pretoria, 1958. (With Summaries in English & French.)

The following is virtually the authors' English summary. In April 1953, aldrin, dieldrin and chlordane were applied to separate experimental plots in a vineyard at Stellenbosch at the rate of 4 lb. technical material per morgen [about 2 acres]. The insecticides, mixed with moist sand, were broadcast evenly over the surface of the soil, after which the soil was immediately cultivated. At the time of treatment, the vines in all the plots were heavily infested with *Iridomyrmex humilis* (Mayr) and mealybugs (chiefly *Planococcus citri* (Risso)). Eight months subsequent to treatment, the ants had disappeared and the vines were free from mealybugs. Four years after treatment, effective control of both pests was still being maintained. At this stage, the soil in all treated plots remained highly toxic to the ants [*cf. R.A.E.*, A **45** 400], and in the case of dieldrin and chlordane more than half the original amount of insecticide was still present in the soil. The aldrin concentration showed a sharp decrease.

Dippenaar (B. J.). **Concentric Ring Blotch of** *Citrus*: **its Cause and Control.**—*S. Afr. J. agric. Sci.* **1** no. 1 pp. 83–99, 8 pls. (2 col.), 9 refs. Pretoria, 1958. (With Summaries in Afrikaans & French.)

The history, distribution in southern Africa and symptoms of the disorder of *Citrus* known as concentric ring blotch are reviewed, together with the investigations in the Transvaal that showed it to be caused by an Eriophyid of the genus *Calacarus* [*cf. R.A.E.*, A **47** 148]. This was described by Keifer in 1955 as a new species, *C. citrifolii*. The author briefly describes all stages of the mite and states that the egg, larval and nymphal stages last 4–5, 2–3 and 3–5 days, respectively. It is suspected that the ring-blotch symptoms are due to the injection of a toxin during feeding. Dissemination of the mite over short distances is effected mainly by wind, but populations rise and fall very suddenly, for reasons that are not understood. All varieties

of *Citrus* seem equally susceptible to attack, and typical symptoms have occasionally been seen on broad-leaved weeds in the orchards and on other plants near *Citrus*. Experiments on control showed that lime-sulphur (1:100) gave the best results, and the recent importance of the mite is considered to have resulted from the disuse of sulphur treatments that followed the advent of organic compounds such as parathion.

Proceedings of the Tenth International Congress of Entomology, Montreal, August 17–25, 1956. Section on Systematics.—*Proc. 10th int. Congr. Ent.* **1** pp. 87–465. Ottawa, 1958.

The following are abstracts of selected papers containing hitherto unpublished information of which the text is printed in full in this section [*cf.* also *R.A.E.*, B **47** 74].

Coppel (H. C.) & Leius (K.). **Morphological Variations in Populations of the Larch Sawfly, *Pristiphora erichsonii* (Htg.) (Hymenoptera: Tenthredinidae), from Canada, Great Britain, and Japan,** pp. 231–238, 6 figs., 11 refs. The following is the authors' abstract. A morphological comparison was made of adult females of the larch sawfly, *Pristiphora erichsonii* (Htg.), from Great Britain, Canada and Japan. Four characters, three measurable and one descriptive, were employed. Morphometric analyses of these characters showed that the populations from the three countries were separable and that there was a closer affinity between Canadian and Japanese populations than between Canadian and British populations.

Ghesquière (J.). **Le premier oviparasite de psylle et son hôte *Trioza erythreae* (Del Guercio) au Congo belge (Hymenoptera: Chalcidoidea, Encyrtidae; Hemiptera: Psyllidae),** pp. 275–280, 11 figs., 35 refs. (With a Summary in English.) *Trioza erytreae* (Del G.) [*cf.* A **24** 650] is an important pest of *Citrus* in the Belgian Congo, where it is widely but sporadically distributed and also infests various forest trees. Damage is particularly severe in nurseries. The eggs of this Psyllid were observed to be parasitised on lemon in Kivu Province by an Encyrtid described from the adults of both sexes as *Psyllechthrus oophagus*, gen. et sp.n. This parasite was easily reared in the laboratory, development from egg to adult being completed in 14–18 days. The percentage parasitism ranged from 11 to 96. No other insect parasites of Psyllid eggs are known [*cf.* A **46** 491].

Stephen (W. P.). **Hemolymph Proteins and their Use in Taxonomic Studies,** pp. 395–400, 2 figs., 9 refs. Since comparative protein analysis, which distinguishes large categories of organisms qualitatively, might be useful for differentiating between populations of polytypic forms, the haemolymph proteins of adult female insects of seven species were studied by procedures that are described. *Periplaneta americana* (L.) and *Blatta orientalis* L. showed a quantitative and qualitative similarity in two of the protein fractions found; a third fraction was peculiar to *B. orientalis*, but occurred in only trace amounts. The other species used, which comprised *Oncopeltus fasciatus* (Dall.), *Phormia regina* (Mg.), *Smerinthus cerisyi* Kby., *Pleocoma minor* Linsley and *Lichnanthe rathvoni* (Lec.), showed considerable differences in protein fractions.

Patel (G. A.), Katarki (H. V.) & Patel (N. G.). **Field Experiments on insecticidal Control of the Cotton Jassid, *Empoasca devastans* Distant.** —*Indian J. Ent.* **19** pt. 1 pp. 23–30, 12 refs. New Delhi, 1957.

Empoasca devastans Dist. has long been known in Bombay State as a pest of *Hibiscus esculentus*, but was of little importance on cotton until the recent introduction of long-stapled broad-leaved varieties, which proved very susceptible to it. Plot tests on control by means of sprays and dusts were

begun in 1951, their effectiveness being estimated from the reduction in nymphal population obtained, and the following is based on the authors' summary of the results. Sprays of DDD, toxaphene and DDT at 0·2 per cent. were equal in toxicity and superior to nicotine sulphate at 1:800. A dust of 5 per cent. DDT, 3 per cent. γ BHC as lindane and 40 per cent. sulphur was about as effective as one of equal parts of sulphur and 5 per cent. DDT, and both were significantly superior to similar mixtures of sulphur with DDD or chlordane. A spray containing 0·2 per cent. of a wettable mixture of DDT and micronised sulphur was superior to an equal concentration of BHC, DDD alone or with sulphur and 0·2 per cent. of a mixture of BHC and DDT, but not all the differences were significant. A spray affording 2 oz. endrin per acre was as effective as 0·01 or 0·02 per cent. parathion or the mixture of DDT and sulphur and cheaper than the latter. Effectiveness was not significantly increased by raising the concentration of parathion to 0·03 per cent. or doubling the rate of application of endrin.

Subramanian (T. R.). **Life-history of the *Calotropis* or "Ak" Weevil *Paramecops farinosa* Wiedemann.**—*Indian J. Ent.* **19** pt. 1 pp. 31–36, 5 figs., 6 refs. New Delhi, 1957.

Calotropis gigantea, an important green-manure plant used largely for fertilising rice fields in southern India, is attacked by several insects, of which *Poekilocerus pictus* (F.), *Danaus* (*Danais*) *chrysippus* (L.) and *Paramecops farinosa* (Wied.) are the most important. *P. farinosa*, all stages of which are described, occurs wherever the plant is grown and causes considerable damage; it has not been recorded as attacking any other plant. This weevil is present throughout the year at Coimbatore, but breeds in largest numbers in June–December. The adults feed on the leaves, causing them to dry and drop, and on the flower buds and fruits, and the larvae bore in the fruits. The adults pair soon after emergence, and laboratory tests in 1954 showed that the preoviposition and oviposition periods last 5–9 and 25–82 days, respectively. The females laid 46–362 eggs each, at the rate of 5–8 a day. The eggs were deposited in small groups in the mesocarp of the fruit and hatched in 5–7 days at average maximum and minimum temperatures of 87·9 and 77·3°F. The larvae bored into the fruit and fed on the seeds, becoming full-fed in 20–24 days and pupating in the fruit in cocoons made of the floss. The adults emerged after 8–10 days and left the cocoons three days later, usually after they had fallen to the ground from the burst fruit. Adult males and females lived for 28–118 and 32–134 days, respectively.

Nair (M. R. G. K.). **Structure of waterproofing epicuticular Layers in Insects in Relation to Inert Dust Action.**—*Indian J. Ent.* **19** pt. 1 pp. 37–49, 11 graphs, 8 refs. New Delhi, 1957.

Since inert dusts kill insects by removing or abrading the waxy waterproofing layer of the cuticle and so exposing them to desiccation [*cf. R.A.E.*, A **34** 60, etc.], it was thought that their effectiveness might be correlated with variations in the structure of this layer in different species. Investigations were therefore made with adults of *Calandra oryzae* (L.), *Tribolium castaneum* (Hbst.), *Rhizopertha dominica* (F.) and *Callosobruchus* (*Bruchus*) *chinensis* (L.). The structure of the waterproofing layer was examined by chloroform treatment, and found to comprise a wax layer protected by a cement layer in *Calandra*, an exposed layer of very hard wax in *Tribolium*, an exposed layer of softer wax in *Rhizopertha*, and one of very soft wax in *Callosobruchus*. Tests of the effect of inert dusts were carried out in specimen tubes, finely powdered magnesite, kaolin and rice-husk charcoal

being used at a relative humidity of 73·5 per cent. Magnesite proved the most effective, causing complete kill of *Callosobruchus* in two days, *Rhizopertha* and *Calandra* in three days and *Tribolium* in five days, and the other dusts, though less rapid in action, affected the insects in the same order. The unexpected susceptibility of *Calandra* as compared with *Rhizopertha* and *Tribolium* was apparently due to its lower water content. The amount of magnesite that adhered to groups of ten living insects was least for *Rhizopertha*, greatest for *Callosobruchus* and greater for *Tribolium* than *Calandra*. For insects killed by ammonia vapour, the amount increased in the order *Rhizopertha*, *Calandra*, *Tribolium* and *Callosobruchus*, and for those subsequently treated with boiling chloroform the corresponding order was *Rhizopertha*, *Tribolium*, *Calandra* and *Callosobruchus*, this wax-removing treatment greatly reducing the amount of dust that adhered to *Callosobruchus* and *Rhizopertha*. That insect activity was not responsible for differences in effectiveness was shown by exposing dead insects to magnesite in a dry atmosphere. There was no increased loss in weight due to transpiration for *Calandra*, but small losses for *Tribolium* and *Rhizopertha* and a somewhat greater one for *Callosobruchus*, evidently owing to adsorption of the cuticular lipoids by the dust. The difference in effectiveness between magnesite and the other two dusts was very great for *Calandra* and *Tribolium*, but much less for *Callosobruchus* and *Rhizopertha*, showing that although highly abrasive dusts are required to kill insects with a strong waterproofing mechanism, softer ones are almost as effective against less well protected species [*cf.* **38** 306].

Mohammad Ali (S.). **Some bio-ecological Studies on** *Pseudococcus vastator* **Mask. (Coccidae: Hemiptera).**—*Indian J. Ent.* **19** pt. 1 pp. 54–58, 4 figs., 6 refs. New Delhi, 1957.

In India, *Nipaecoccus* (*Pseudococcus*) *vastator* (Mask.) (*perniciosus* Newst. & Willc.) is a serious pest of *Citrus* in Aligarh and also occurs on *Euphorbia hirta* and *Dalbergia sissoo*. Investigations begun in 1952 showed that the population of this mealybug was low from July to mid-September, but then increased rapidly, so that infestation was heavy by November. The females deposited 416–727 eggs each in the field, in an ovisac secreted under the body, but not nearly so many in the laboratory. At 20 and 30°C. [68 and 86°F.], the percentage hatch was greatest (70·6 and 48·6) at a relative humidity of about 66 per cent.; at 81 and 93 per cent. relative humidity, it decreased sharply at 20°C. and ceased at 30°C. The incubation period lasted 7–10 days. The nymphs fed in the vicinity of the ovisac if they found a suitable position, but moved away to leaves, twigs or stem crevices otherwise. At 32·5°C. [90·5°F.] and 72 per cent. relative humidity, the first two nymphal stages lasted about five days each, the prepupal and pupal stages of the males about 2·5 days each and the third nymphal stage of the females 9·5 days. The adult males are active and capable of swift flight, and lived for up to three days. Females survived for up to 51 days, usually dying soon after completing oviposition.

Narayanan (E. S.) & Bhambhani (H. J.). **Fumigation under reduced Pressures with Carbon Disulphide against** *Tribolium castaneum* **Herbst (Tenebrionidae: Coleoptera) and** *Trogoderma granarium* **Everts (Dermestidae: Coleoptera).**—*Indian J. Ent.* **19** pt. 1 pp. 59–62, 1 graph, 6 refs. New Delhi, 1957.

In the investigations described, batches of 25 adults of *Tribolium castaneum* (Hbst.) or larvae of *Trogoderma granarium* Everts were fumigated

with carbon bisulphide in 31-litre steel chambers for three hours at atmospheric or reduced pressures and examined for mortality 9 and 15 days later, respectively. The temperature was maintained at 81–86° F. The LD50's at pressures of 140, 300 and 500 mm. mercury and atmospheric pressure, respectively, were 49, 89·1, 154·9 and 169·3 mg. per litre for *Tribolium* and 72·4, 117·5, 218·8 and 229·1 mg. per litre for *Trogoderma*. It is concluded that fumigation is more effective at reduced than at atmospheric pressure and that the larvae of *Trogoderma* are more resistant than the adults of *Tribolium*.

Butani (D. K.). **A Tachinid Fly Parasite of** *Chilo zonellus* **Swinhoe.**—*Indian J. Ent.* **19** pt. 1 pp. 62–63. New Delhi, 1957.

The author records the finding of seven parasites attacking *Chilo zonellus* (Swinh.), a major pest of maize, sorghum and sugar-cane, in Bombay State. They are *Glyptomorpha deesae* (Cam.), *G.* (*Stenobracon*) *nicevillei* (Bingham), *Xanthopimpla pedator* (F.), *X. nursei* Cam., *Tetrastichus* sp., an unidentified Phorid and an unidentified Tachinid. The last, which is briefly described, was the most important, being active from August to November and parasitising up to 50 per cent. of the larvae of *Chilo* in mid-September.

Puttarudriah (M.) & Usman (S.). **Flood causes Army-worm Outbreak.**—*Mysore agric. J.* **32** (1957) no. 3–4 pp. 124–131, 1 pl., 8 refs. Bangalore [1958].

Accidental flooding in the Kunigal district of Mysore State in October 1956 was followed by an outbreak of *Pseudaletia* (*Leucania*) *unipuncta* (Haw.), which caused severe damage to sugar-cane, a crop not previously attacked by the armyworm in that State. Other crops were less seriously injured. All stages of the Noctuid, its bionomics and the damage caused are described, and the results of rearing experiments in the laboratory are recorded. The life-cycle was unusually prolonged in individual rearings, but in mass rearings, in which about 50 individuals were reared together and conditions were closer to those in nature, the egg, larval and pupal stages averaged 4·5, 22·5 and 8 days, respectively. In tests on various crops, complete control was given by sprays of BHC, parathion, DDT or calcium arsenate and a sweetened bait of bran and sodium fluosilicate. Two other outbreaks of *P. unipuncta* on sugar-cane in India following the receding of floods have occurred in recent years [*cf. R.A.E.*, A **45** 69].

Puttarudriah (M.) & Channa Basavanna (G. P.). *Carcelia evolans kockiana* **Tns. (Tachinidae, Diptera), a new Parasite of the Lab Lab Podborer,** *Adisura atkinsoni* **Moore (Agrotidae, Lepidoptera).**—*Mysore agric. J.* **32** (1957) no. 3–4 pp. 138–139, 1 pl., 4 refs. Bangalore [1958].

In addition to the three species of Hymenoptera already recorded [*R.A.E.*, A **45** 463], *Carcelia evolans kockiana* (Tns.) is recorded parasitising the larvae of *Adisura atkinsoni* Moore on *Dolichos lablab* in Mysore State. Parasitism by the Tachinid was low, not exceeding 2·5 per cent., and occurred chiefly towards the end of the crop season.

Murthy (D. V.). **Studies on the Bionomics of the Paddy Gall-midge—***Pachydiplosis oryzae* **(W.M.) Mani.**—*Mysore agric. J.* **32** (1957) no. 3–4 pp. 145–153, 17 refs. Bangalore [1958].

Pachydiplosis oryzae (Wood-Mason) is a serious pest of rice in many parts of India, and its bionomics, economic importance and control are reviewed

in some detail from the literature [*cf. R.A.E.*, A **34** 119; **44** 218, 428; **45** 141]. Observations in the Nizamabad district of Andhra Pradesh showed that the larval and pupal stages of the Cecidomyiid last 8–15 and 2–6 days, respectively, in August–September and that infestation increases with lateness of sowing of the first crop of the season.

Puttarudriah (M.) & Channa Basavanna (G. P.). **Some Insect Predators of Aphids (Aphididae) in Mysore.**—*Mysore agric. J.* **32** (1957) no. 3–4 pp. 158–161. Bangalore [1958].

A list is given of 35 species of insects that prey on aphids of economic importance in Mysore, showing the aphids concerned, the localities and months in which they are active and their frequency. Most of them are Coccinellids. The work was undertaken with a view to studies on the bionomics of the predators and their possible use in biological control.

Channa Basavanna (G. P.) & Puttarudriah (M.). **Some Predators of Mites in Mysore.**—*Mysore agric. J.* **32** (1957) no. 3–4 pp. 179–185, 13 refs. Bangalore [1958].

Notes are given on numerous insects that are predacious on mites infesting plants of agricultural importance in Mysore State. One of the most useful is *Stethorus pauperculus* (Weise) [*cf. R.A.E.*, A **36** 427], which attacks *Oligonychus indicus* (Hirst) on sorghum, *Eotetranychus hirsti* Pritchard & Baker on fig, *Tetranychus telarius* (L.) on various plants and *Eutetranychus banksi* (McG.) on castor [*Ricinus communis*]. The larvae and adults of this Coccinellid, both of which feed on mites, are briefly described.

Henderson (M.). **A Test of Spray Deposits on Cacao Foliage using a Fluorescent Tracer.**—*Malay. agric. J.* **40** no. 4 pp. 269–274, 1 pl., 1 ref. Kuala Lumpur, 1957.

In view of uncertainty as to whether the application of insecticides to cacao in the form of fogs results in satisfactory deposits, investigations were made in Malaya in 1957. The following is substantially the author's summary of this account of the work. A fluorescent compound, zinc-8-hydroxyquinolinate, was used to detect the deposits and was applied in fogs and mist sprays according to the normal practices. The results indicate that both wet and dry fogs give some deposit on the foliage, but only on trees fairly close to the line of application. The amount of deposit given by these methods of application and its distribution over the foliage as a whole and on individual leaves would probably not result in an effective coverage of insecticide. Mist-spraying appears to be a far more efficient method of distributing the same amount of material evenly over the foliage to give a residual deposit, but the relative costs were not considered.

Henderson (M.). **Insecticidal Control of the Diamond Back Moth (*Plutella maculipennis* Curt.) on Cabbages at Cameron Highlands.**—*Malay. agric. J.* **40** no. 4 pp. 275–279, 1 pl., 1 ref. Kuala Lumpur, 1957.

Sprays of DDT or BHC satisfactorily controlled *Plutella maculipennis* (Curt.) on cruciferous crops in Malaya until 1956, when reports were received from Singapore, Johore and the Cameron Highlands that they were losing

their effectiveness. Dieldrin was also stated to be giving poor results in the Cameron Highlands. Experiments were therefore carried out in the latter region in 1957. Cabbages were sprayed at weekly intervals from transplanting to a fortnight before harvest, and the numbers of larvae on four outer leaves of sample plants were counted weekly over the same period. The total numbers of larvae were reduced from 758 for no treatment to 13 by 0·04 per cent. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 24 by 0·28 per cent. malathion, 105 by 0·15 per cent. dieldrin, 707 by 0·15 per cent. DDT and 740 by 0·03 per cent. γ BHC. All treatments resulted in significant increases in yield, the order of effectiveness being the same as before, and diazinon quadrupled the weight of cabbages harvested per plot. Only dieldrin left any appreciable residue.

Viado (G. B.), Banaag (A. F.) & Luis (R. A.). **Some organic Insecticides in the Control of the Corn Earworm and the Corn Borer on green Corn.** —*Philipp. Agric.* **41** no. 7 pp. 402–411, 33 refs. College, Laguna, 1957.

Three tests were carried out in the Philippines in 1956–57 on the control of *Heliothis armigera* (Hb.) and *Pyrausta nubilalis* var. *salentialis* (Sn.) on a susceptible variety of maize. Insecticides were applied to the ears and the upper parts of the stems just below them, and damage was assessed before and after the ears were husked. Injury by *H. armigera* is difficult to detect before husking, but that by *P. n. salentialis* is easily seen because of the holes bored through the husk, unless the larva enters the ear through the peduncle. In the first test, carried out in the rainy season of 1956, three applications were made at five-day intervals and the total percentages of sound ears were greatest for a 25 per cent. DDT emulsion concentrate and a 19·5 per cent. endrin emulsion concentrate, both at 2 quarts per 100 gal., when injury was assessed from the unhusked and husked ears, respectively. On the husked ears, the latter reduced the percentage infestation from 21·97 to 9·43 for *Heliothis* and from 11·49 to 3 for *Pyrausta*, both differences being significant. In the second test, in the dry season of 1956–57, four applications were made at three-day intervals, and the best results were given by the DDT concentrate at 6 quarts per 100 gal., which reduced the percentage infestation on the unhusked and (in brackets) the husked ears from 7·08 (6·8) to 1·83 (1·55) for *Heliothis* and from 16·24 (8·34) to 3·25 (0·72) for *Pyrausta*, the differences being highly significant. In the third test, in the rainy season of 1957, four applications were again made at three-day intervals, and the best results were given by 3 quarts of the DDT concentrate with 1 pint of the endrin concentrate per 100 gal., which reduced the percentage infestation in unhusked and (in brackets) husked ears from 83·49 (11·77) to 16·79 (0·35) for *Heliothis* and from 9·6 (3·3) to 0 (0) for *Pyrausta*, the differences being highly significant. This treatment also gave the highest mean yield of undamaged ears.

Barrie (J. W.). **Coffee in the Highlands.**—*Papua New Guinea agric. J.* **11** (1956) no. 1 pp. 1–29, 15 figs., 3 refs. Port Moresby [1958].

This paper on the growing of coffee in the highlands of New Guinea contains a short section on the pests and diseases that attack the tree there. None is of great importance. The insects include *Cryptorhynchus* sp., of which the larvae tunnel beneath the bark and girdle the main stem, causing the top to wilt or die, *Oribius destructor* Mshl. and *O. hostis* Mshl., of which the adults feed on the leaves [*cf. R.A.E.*, A **45** 215], *Homona coffearia* (Nietn.), which also injures the leaves, and several Coccids, which are attacked by Coccinellids. Very brief notes on control are included.

Szent-Ivany (J. J. H.) & Barrett (J. H.). **Some Insects of Banana in the Territory of Papua and New Guinea.**—*Papua New Guinea agric. J.* **11** (1956) no. 1 pp. 40–44, 12 figs., 5 refs. Port Moresby [1958].

The only insects so far recorded from banana in the Territory of Papua and New Guinea are *Cosmopolites sordidus* (Germ.), *Nacoleia octasema* (Meyr.) and *Papuana woodlarkiana* (Montr.) (*laevipennis* Arr.). Others have been observed in recent years, and notes on these are here given. They include the Dynastids, *Scapanes grossepunctatus* Sternb. and *S. australis* Boisd., which bore in the pseudostems in New Britain and Papua, respectively, and of which both also attack coconut and *S. grossepunctatus* manila hemp (*Musa textilis*); *Dacus* (*Strumeta*) *musae* (Tryon) in Papua and New Guinea; adults of *Dermolepida nigrum* (Nonfried) in Papua; and *Apirocalus cornutus* Pasc., a weevil that attacks the leaves and flowers at Madang, and *Taenaris myops kirschi* Stgr., an Amathusiid of which the larvae defoliate the plants, and an unidentified Mirid, an unidentified Derbid and *Stephanitis* sp., near Port Moresby, in New Guinea.

Hoy (J. M.). **Coccids associated with Rata and Kamahi in New Zealand.**—*N.Z. J. Sci.* **1** no. 2 pp. 179–200, 9 figs., 1 map, 5 refs. Wellington, N.Z., 1958.

Metrosideros umbellata (southern rata) and *Weinmannia racemosa* (kamahi) are the dominant trees in the forests that grow on the steep mountain slopes of the Westland Province of the South Island of New Zealand, and *M. robusta* (northern rata) and *W. racemosa* are important constituents of the submountain forests in the south of the North Island. These trees have suffered high mortality of recent years, and a survey was undertaken in 1955 to elucidate the possible importance of Coccids in causing it. The three trees were inspected throughout their distribution range in the two islands, *M. excelsa* (pohutukawa) was also surveyed in some places, and material was further seen from Stewart Island. Information is here given on the habits, food-plants, distribution and abundance of the Coccids found. Seven species, including three described as new, were observed on *Metrosideros* spp.; all were widely distributed, and all, except an undescribed species of *Coelostomidia* near *C. pilosa* (Mask.), were confined to trees of this genus. The new species are *Capulinia orbiculata* on *M. robusta* and *M. umbellata*, *Eriococcus rata* on *M. robusta* and *Metrosideros* sp., and *E. pohutukawa* on *M. excelsa*. Coccids are not considered to be primary factors causing large-scale mortality of *M. umbellata* or *M. robusta*, although *Anoplaspis metrosideri* (Mask.) and *C. orbiculata* appeared to be seriously detrimental to individual trees of either species when they occurred in large numbers on them. *E. pohutukawa* was implicated in mortality of *M. excelsa*, on which it was the only insect present, since infested trees sprayed with oil emulsion recovered, whereas unsprayed ones did not. Nine species, including one described as *E. kamahi*, sp.n., the species near *Coelostomidia pilosa*, and three others undescribed, were recorded from *W. racemosa*, but only three are restricted to it. Most of them were local in occurrence, and none is considered of importance as a cause of tree mortality.

Davies (M.). **Blowfly Damage to Bacon: a new Method of Protection.**—*Pyrethrum Post* **4** no. 2 pp. 28–33, 3 figs., 4 refs. London, 1957. (Repr. from *Proc. Inst. cert. Groc.* July 1955.)

Bacon in Britain is liable to infestation by the blowflies, *Calliphora vicina* R.-D. (*erythrocephala* (Mg.)) and *Lucilia sericata* (Mg.), and also by *Piophila*

casei (L.), at all stages during processing, storage and curing. The eggs, which are laid preferably in the moist pockets left after the removal of the bones, hatch in 24 hours, and the larvae feed below the surface and become full-fed in a week. Those of *P. casei* are often difficult to detect unless very numerous, since they burrow deep into the flesh. Attack is most frequent while the bacon is left unprotected in the stove immediately before the stoving process. Insecticide deposits on the inside walls of the stove proved of no value, and space sprays of very little. Pea meal is commonly used for dusting bacon prior to stoving, and the effectiveness of impregnating it with a mixture of pyrethrins and piperonyl butoxide (1:10) was therefore investigated. Pieces of bacon bearing deposits of 4–12 mg. pyrethrins with 40–120 mg. piperonyl butoxide per sq. ft. were exposed over a period of five days to blowflies in gauze cages at 80°F. and 50 per cent. relative humidity and kept under constant illumination for eight hours a day. Fresh flies were introduced after three days. A minimum deposit of 6 mg. pyrethrins with 60 mg. piperonyl butoxide gave complete protection from *C. vicina* for five days and one of 8 mg. pyrethrins with 80 mg. piperonyl butoxide from *L. sericata*; at lower application rates, few eggs were laid and none hatched. Most of the flies were dead at the end of the experiment, whereas, in control cages, all were living and the bacon was heavily infested.

In a practical test, a half side of bacon was dusted, at the usual rate of about $1\frac{1}{2}$ oz. per side, with pea meal to which sufficient pyrethrins mixture to give protection had been added and was then exposed to attack by approximately 2,000 blowflies. It remained free from infestation for four days at 80°F. Tests by several members of the industry confirmed the efficacy of the method. There was some evidence that the effectiveness of the treatment was reduced by the stoving process, but attack after this stage occurs primarily in the moist pockets, and by dusting these with a small amount of the impregnated pea meal, further protection is afforded for several days; such applications can be repeated if necessary and can also be made to green bacon. No hazard to health is involved, and the flavour of the bacon is not affected.

Brumbaugh (J. H.) & Stallard (D. E.). **Colorimetric Determination of residual Perchloroethylene in fumigated Wheat.**—*J. agric. Fd Chem.* **6** no. 6 pp. 465–468, 4 figs., 13 refs. Easton, Pa., 1958.

The following is based on the authors' summary. The use of tetrachloroethylene as a fumigant to control insect infestation in stored wheat makes it necessary to determine the residual amount of this compound present after fumigation. A simple method of doing this, based on a newly found colour reaction, is described; it is not specific for tetrachloroethylene.

Terriere (L. C.), Kiigemagi (U.) & England (D. C.). **Endrin Content of Body Tissues of Steers, Lambs, and Hogs receiving Endrin in their daily Diet.**—*J. agric. Fd Chem.* **6** no. 7 pp. 516–518, 13 refs. Easton, Pa., 1958.

The following is based on the authors' summary. Steers, lambs and hogs that received endrin at 0·1 part per million in their diet for 12 weeks showed little tendency to deposit it in their body tissues. When the rate was increased to 0·25 p.p.m. for 12 weeks, the endrin content of the fat did not exceed 0·2 p.p.m. and no endrin was found in other tissues. The analyses were performed by a method specific for endrin and sensitive to 0·1 p.p.m.

Kiigemagi (U.), Sprowls (R. G.) & Terriere (L. C.). **Endrin Content of Milk and Body Tissues of Dairy Cows receiving Endrin daily in their Diet.**—*J. agric. Fd Chem.* **6** no. 7 pp. 518–521, 12 refs. Easton, Pa., 1958. **Correction.**—*T. c.* no. 8 p. 592.

The following is based on the authors' summary. In the experiments described, dairy cows received endrin at 0·1–2 parts per million in their diet for 12 weeks. Milk samples were analysed for endrin during and after this period, and small amounts were found at all levels of intake. Tissue samples were analysed at the end of the period, and up to 1 p.p.m. endrin was found in the body fat.

Gunther (F. A.), Ewart (W. H.), Blinn (R. C.), Elmer (H. S.) & Wacker (G. B.). **Field Persistence Comparisons of Residues of the Insecticide, Diazinon, in Lemons and Valencia Oranges and Effects on Juice Flavor.**—*J. agric. Fd Chem.* **6** no. 7 pp. 521–523, 2 graphs, 14 refs. Easton, Pa., 1958.

Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate) has recently shown promise for the control of certain pests of *Citrus* in California, notably *Coccus hesperidum* L., and tests on its persistence under field conditions and its effects on fruit flavour were therefore carried out in 1956–57. Orange and lemon trees were sprayed with 2 lb. 25 per cent. wettable powder or 25 per cent. emulsion concentrate per 100 U.S. gal. with conventional machinery, and fruits were collected before and at intervals of up to 28 days after treatment and the minced peel and minced pulp analysed for residues. No diazinon was found in the pulp at any time, and the amounts in the peel decreased rapidly, the half-life being 12–13 days on lemon and 16–17 days on orange. There were no detectable changes in juice flavour.

Gertler (S. I.), Steiner (L. F.), Mitchell (W. C.) & Barthel (W. F.). **Esters of 6-Methyl-3-cyclohexene-1-carboxylic Acid as Attractants for the Mediterranean Fruit Fly.**—*J. agric. Fd Chem.* **6** no. 8 pp. 592–594, 6 refs. Easton, Pa., 1958.

Several esters of 6-methyl-3-cyclohexene-1-carboxylic acid proved effective attractants for males of *Ceratitis capitata* (Wied.) in preliminary tests, especially the isopropyl ester, and this was substituted for angelica seed oil in the lures used in Florida in the campaign against this fruit-fly when world supplies of the oil gave out [*cf. R.A.E.*, A **46** 349]. The sec.-butyl ester was subsequently found to be about twice as attractive as the isopropyl ester when evaporation of the latter was not controlled, and this was used from April 1957.

In the course of the work, 31 esters of the acid were synthesised and tested by an olfactometer method. About one-fourth of them showed considerable attractiveness to the male fruit-flies, and the attractant ratings for these, in comparison with 100 for the isopropyl ester, were 122 for the ethyl, 115 for the 2-bromoethyl, 107 for the allyl, 99 for the isobutyl, 96 for the propyl, 87 for the sec.-butyl and 86 for the 2-chloroethyl esters. The best 11 compounds were applied to wicks in dry traps [**46** 350] at 2–3 ml. per wick, in combination with 0·5 per cent. dimethyl 2,2-dichlorovinyl phosphate as the toxicant, and tested in the field. The ratings, again as compared with

100 for the isopropyl ester, were 279 for the sec.-butyl, 231 for the 1-ethylpropyl, 98 for the butyl and very much lower for the other esters.

Van Middelem (C. H.) & Waites (R. E.). **Demeton Residues in Collards, Lettuce, and Mustard.**—*J. agric. Fd Chem.* **6** no. 8 pp. 594–597, 3 graphs, 8 refs. Easton, Pa., 1958.

A tolerance of 0·75 part per million has been established in the United States for residues of demeton (diethyl 2-(ethylthio)ethyl phosphorothioate) on broccoli, brussels sprouts, cabbage, cauliflower and lettuce, and a waiting period of 21 days between the last foliage application and harvesting of these vegetables has been officially recommended. Investigations were carried out in 1956 to ascertain whether this interval would also prove sufficient for kale (collards) and mustard grown as green vegetables. Sprays of demeton were applied to lettuce and mustard at 2 or 4 oz. and to kale at 4 oz. toxicant per acre. Plant samples were taken at various intervals after treatment, extracts from them were tested for *in vitro* inhibition of human blood cholinesterase by a technique that is described, and the demeton residues were estimated by comparison with a standard curve. The results indicated that the waiting period of 21 days was sufficient for dissipation of the residues from all these crops to within the tolerance limit except when 3–4 applications at 4 oz. per acre were made at weekly intervals preceding it. Applications should therefore be made not less than 2–3 weeks apart.

Telford (A. D.). **Arizona Cotton Insects.**—*Bull. Ariz. agric. Exp. Sta.* no. 286, 60 pp., 42 figs. Tucson, Ariz., 1957.

Notes are given on the appearance and habits of the insects and mites that attack cotton in Arizona and of the insect predators associated with them. The information given is designed to assist growers to identify the pests and the damage caused by them, recognise the common beneficial forms and evaluate the necessity for control measures, and a field key to the insects is included.

Struble (G. R.). **The Fir Engraver. A serious Enemy of western true Firs.**—*Prod. Res. Rep. For. Serv. U.S. Dep. Agric.* no. 11, [1+] 18 pp., 12 figs., 5 refs. Washington, D.C., 1957.

The following is largely the author's summary. *Scolytus ventralis* Lec. is a major cause of tree damage and death in forests of firs (*Abies*) in the western United States. Sporadic outbreaks in both old- and second-growth stands have occurred one or more times each decade since 1925 in California and Oregon, and several epidemics have severely depleted fir stands elsewhere since 1935. White fir (*A. concolor*), lowland white fir (*A. grandis*) and California red fir (*A. magnifica*) are preferred, but Douglas fir (*Pseudotsuga menziesii*), mountain hemlock (*Tsuga mertensiana*), alpine fir (*A. lasiocarpa*) and Engelmann spruce (*Picea engelmanni*) are damaged occasionally. The range of the Scolytid extends from British Columbia to New Mexico and east to the Rocky Mountains. The beetle kills or damages the tree by cutting transverse egg galleries along the cambium layer, girdling the trunk or killing patches of cambium. The larvae mine separate channels at

right angles to the egg gallery along the cambium layer, causing further damage. A staining fungus introduced by *S. ventralis* and found in every attack is apparently an important factor in ensuring the success of the beetle by helping to overcome the resistance of the tree.

The length of the life-cycle depends on temperature. In the central Sierra Nevada, one generation is produced each year at elevations between 4,500 and 6,000 ft., one every two years at elevations above 6,000 ft. on north exposures, and one and a partial second each year at elevations between 3,500 and 4,500 ft. on south exposures, the larvae remaining dormant during the winter.

When populations are low, and also presumably when tree growth and resistance are at a maximum, *S. ventralis* tends to confine its attacks to old or weakened trees, killing the tops or patches of cambium along the bole. It often attacks and kills new leaders that grow out to replace the old tops. This frequently continues on the same trees for several years, each season of attack resulting in additional crown injury, until the tree is weakened beyond recovery. In vigorous trees, injured patches of cambium ordinarily heal over and the scars are buried in the wood. During outbreaks, entire trees and groups of trees are killed in a single season and trees of all sizes above 4 inches in diameter at breast height may be attacked without apparent choice as to site or growth rate. Trees weakened by *S. ventralis* are readily attacked and killed by several species of associated secondary insects, the most important of which is *Tetropium abietis* Fall.

Natural control is afforded by several insect parasites and predators, which increase in numbers with the numerical increase of the beetle. Artificial control measures are limited because of the wide variation in injury to the tree and in brood establishment. Unless the broods in top-killed trees or in partly injured boles can be destroyed, the benefit from destroying broods in dead trees is largely nullified. Insecticides that offer promise are oil sprays containing either ethylene dibromide (2 lb. per 5 U.S. gal. fuel oil), or o-dichlorobenzene (8 lb. per 5 U.S. gal. fuel oil). The best possibilities for minimising damage sometimes lie in the removal of decadent and weakened firs and in improving the growth and vigour of the remaining stand.

Jacobson (L. A.) & Blakeley (P. E.). **Influences of Temperature and Moisture on Hatching of Eggs of the Pale Western Cutworm, *Agrotis orthogonia* Morr. (Lepidoptera: Noctuidae).**—*Canad. J. Pl. Sci.* **38** no. 2 pp. 127–134, 3 graphs, 5 refs. Ottawa, 1958.

In western Canada, adults of *Agrotis orthogonia* Morr. are active between 15th August and 15th September, the females oviposit mainly in the second and third weeks of this period, embryonic development takes place during the autumn, and the eggs hatch in late March or early April. The effect of climatic factors on the survival and hatching of the eggs under prairie conditions was assessed in 1954–56, and the following is largely the authors' summary of the results. Laboratory studies showed that the rate of hatching and the percentage hatch varied directly with temperature and relative humidity, that prolonged exposure to temperatures between −5 and −15°C. [23 and 5°F.] did not affect ultimate hatch, and that desiccation, particularly between 20 and 30°C. [68 and 86°F.], caused considerable mortality of embryos. Outdoor studies showed that 45–60 days were required in autumn for the completion of embryonic development and that most eggs hatched in early spring. It is concluded that the eggs are admirably adapted to develop, withstand climatic factors, and hatch at a time when survival is ensured.

Read (D. C.). **Factors influencing Infestation and Injury of Rutabagas by Root Maggots (Diptera: Anthomyiidae) in Prince Edward Island. I. Field Studies.**—*Canad. J. Pl. Sci.* **38** no. 2 pp. 188–198, 2 pls., 3 graphs, 13 refs. Ottawa, 1958.

The following is based on the author's summary. In the course of investigations on the root maggots that attack swedes in Prince Edward Island, where this crop is grown extensively, more than 100 swede fields were examined each year from 1951 to 1955. *Hylemyia brassicae* (Bch.) was the only species found causing primary damage. *H. trichodactyla* (Rond.), *H. cilicrura* (Rond.) and *Muscina stabulans* (Fall.) were associated with *H. brassicae*, but did not injure the roots. Adults of *H. brassicae* first emerged from overwintered puparia early in June in areas on sandy soil and late in July in areas of clay-loam. Heavy texture and high moisture content of the latter soils were closely correlated with the delay in emergence. The females laid their eggs near swede plants, usually in crevices in the soil, and the larvae fed in the roots, usually entering them at a depth of an inch or more below the soil surface. In general, early-sown swedes in sandy-soil areas and late-sown ones in clay-loam areas were severely damaged, whereas late sowings in sandy areas and early ones in clay-loam areas were lightly infested. However, in sandy-soil areas in which all the swede crops were harvested early in August, damage was relatively light. Also, fields isolated by other swede fields from sources of infestation, such as storage bins and infested swede crops of either the current or the previous season, were usually only lightly damaged. The use of farmyard manure increased infestation by *H. brassicae* early in the season, but did not significantly influence total damage.

Read (D. C.) & Cannon (F. M.). **Control of Root Maggots in Rutabagas in Prince Edward Island.**—*Canad. J. Pl. Sci.* **38** no. 3 pp. 307–313, 1 pl., 1 graph, 7 refs. Ottawa, 1958.

The following is based largely on the authors' summary. In tests on the control of *Hylemyia* spp., chiefly *H. brassicae* (Bch.), attacking swedes in Prince Edward Island [*cf.* preceding abstract], the numbers of infested plants in fields sprayed with DDT against the adults in 81 tests in 21 localities during 1952–55 were in general reduced by 50–90 per cent., as compared with those in neighbouring untreated fields. The sprays were applied at 1 lb. toxicant per acre at weekly intervals during the emergence period of the adults of the overwintered generation, which varied with soil type [*loc. cit.*]. In eight plot experiments in 1955, a pre-sowing treatment with heptachlor applied as a wettable powder at 5 lb. per acre in a 5-in. band, 1½ in. below the seed in the ridge, gave an average of 93 per cent. control, and similar treatment with aldrin gave 80 per cent. Neither material was as satisfactory when applied at 2·5 or 5 lb. in a 1-in. band at the same depth, and heptachlor was considerably less effective in granules than in the powder when applied as a 5-in. band. Sprays of heptachlor and aldrin at 3 and 7 lb. toxicant per acre, respectively, applied three times after thinning to the crowns of the plants and the surface of the surrounding soil were ineffective. None of the treatments injured the plants.

Kasting (R.), McGinnis (A. J.) & Longair (E. L.). **Moisture and Nitrogen Contents of Stem Tissues from solid- and hollow-stemmed Varieties of Spring Wheat and their Relation to Sawfly Resistance.**—*Canad. J. Pl. Sci.* **38** no. 3 pp. 287–291, 4 refs. Ottawa, 1958.

The following is almost entirely the authors' summary of this account of investigation in Alberta on the relation between the contents of nitrogen and

moisture in the stem tissues of varieties of spring wheat and their resistance to attack by *Cephus cinctus* Nort. [*cf. R.A.E.*, A **43** 436]. Except in the top internode, the contents of nitrogen and moisture in the pith of two solid-stemmed, resistant varieties (Rescue and Golden Ball) were not greatly different from those of the wall of a hollow-stemmed, susceptible variety (Thatcher) 80 and 98 days after sowing. In the stem walls, these contents varied according to variety, position of the internode, and date of harvest. The nodes of one resistant variety (Golden Ball) contained significantly greater quantities of moisture and nitrogen than those of the other and of the susceptible variety. The results indicate that, for the stages of plant growth investigated, quantitative deficiencies in moisture and nitrogen in resistant varieties are not responsible for the poor development of the larvae in them.

Lee (P. E.) & Robinson (A. G.). **Studies on the Six-spotted Leafhopper, *Macrostelcs fascifrons* (Stål), and Aster Yellows in Manitoba.**—*Canad. J. Pl. Sci.* **38** no. 3 pp. 320–327, 2 pls., 3 figs., 3 refs. Ottawa, 1958.

Macrosteles fascifrons (Stål) is the only known vector of the virus of aster yellows in Manitoba, where, before 1950, the disease caused by it was occasionally reported on carrot. Since that year, the Cicadellid has been present in very large numbers, and the disease has caused losses of up to 100 per cent. among lettuce crops and increased losses of other crops and ornamental plants. The bionomics of *M. fascifrons* and its relation to the virus were investigated in 1955–57, and the following is partly based on the authors' summary of the results. Evidence from nymphal and adult counts suggested that adults migrate from the south into Manitoba each year and produce one generation before autumn. Lettuce was greatly preferred to four other plants for oviposition; the adults fed least on flax, which, however, was attractive late in the season when, unlike the others, it produced tillers, but they showed little discrimination among the other four plants. The relation between *M. fascifrons* and the disease was demonstrated in cage tests in which lettuces free from the virus were produced when the Cicadellid was excluded. Of eight lettuce varieties tested, none was resistant to the disease and only one showed any degree of tolerance. Transmission tests with celery and *Zinnia* indicated the presence of the western, or Californian, strain of the virus [*cf.* also *R.A.E.*, A **46** 388]; the eastern, or New York, strain attacks lettuce, but not celery or *Zinnia*.

Gershenzon (S.). **The Polyhedral Virus of the Large Wax Moth (*Galleria mellonella* L.).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **113** no. 5 pp. 1161–1162, 4 figs., 5 refs. Moscow, 1957.

A polyhedrosis of the larvae of *Galleria mellonella* (L.) was described in 1950 by O. I. Shvetsova, who found that the virus was also infective for *Achroia grisella* (F.) but not for *Antheraea pernyi* (Guér.). In experiments by the author, it proved not infective for *Bombyx mori* (L.), *Lymantria* (*Ocneria*) *dispar* (L.) or *Malacosoma neustria* (L.), but highly pathogenic to the larvae of several Nymphalids. The polyhedra and the virus particles contained in them are described, and the name *Borrelina galleriae* is proposed for the virus. It is of the nuclear type.

Olenov (Yu. M.). **The Rôle of Selection and direct Adaptation in the Increase of Resistance to the Action of Insecticides.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **118** no. 2 pp. 414–416. Moscow, 1958.

F_1 females of 20 lines of *Drosophila melanogaster* Mg. derived from wild adults caught near Idritsa in August 1955 proved about as susceptible to contact with a DDT deposit as females of a susceptible laboratory strain, and no increase in resistance occurred in 30–40 generations when the larvae were reared in a medium containing a sublethal concentration of DDT. When, however, selection without exposure to DDT was tested by inbreeding brothers and sisters of the most resistant flies in each generation, a very considerable increase in resistance was evident in five generations, but the inbreeding had resulted in serious loss of fertility. The experiment was therefore continued by breeding from unexposed flies of the most resistant mass cultures. Resistance continued to increase; it was 100 times as great after 11 generations as it had been initially, and its level was maintained in subsequent generations reared in the same way.

Report of the first FAO Meeting on the Control of the Senn Pest of Cereals held at Ankara, Turkey, from 3 to 7 December, 1956.—*Mtg Rep. Fd Agric. Org.* no. 1956/25, [1 +] ii + 20 pp., 4 maps, multigraph. Rome [1957].

This meeting on the Pentatomid bugs that injure cereals was attended by delegates from Persia, Syria and Turkey and observers from Morocco, the United States and the Soviet Union, and the discussions held are summarised at some length in the report.

Some 15 Pentatomids of the genus *Eurygaster* occur in the Palaearctic region, but only *E. integriceps* Put., *E. maura* (L.) and *E. austriaca* (Schr.) have been reported as injurious to cereals. Several species of *Aelia* cause similar damage. *E. integriceps* is the most important species in Persia, where it is widespread and is accompanied by *Aelia acuminata* (L.), *A. furcula* Fieb., *A. rostrata* Boh. and *A. virgata* Klug, and also in Syria, where the two main regions of attack are near Hamma and Aleppo, in the west and north-west, and in the extreme north-east, where *A. rostrata* also occurs, and in Turkey, where it predominates in the south and south-east and *Aelia* spp. in the centre, but the principal species on cereals in Morocco are *E. austriaca* and *A. germari* Küst. The distribution of the infested areas in these countries is shown on maps. Wheat is the principal crop affected, but barley is also attacked, though it usually matures too early to be heavily infested. The bugs suck the sap of the young stems in spring and the developing spikes in summer, preventing the formation of grain or reducing the baking qualities of the flour.

The bionomics of the two genera differ, and they are illustrated by accounts of those of *E. integriceps* in Persia [*cf. R.A.E.*, A **41** 28] and *A. germari* in Morocco [*cf.* **45** 444, etc.]. The ecology of the bugs in the various countries is discussed. There is little evidence of periodicity in attack, and little work has been done on the forecasting of outbreaks in the Near East, though interesting results have been obtained in the Soviet Union [*cf.* **47** 143]. Control of the overwintering bugs is impracticable, but insecticides give good results on the growing crop. Sprays of wettable DDT have given good control in Persia, and parathion proved effective in tests in several countries. Success has been achieved in Persia by breeding and releasing *Microphanurus semistriatus* (Nees), which parasitises the eggs of *E. integriceps* [*cf.* **41** 29], but a laboratory host without an obligatory diapause would be necessary for efficient parasite production. The organisation of research in the various countries is reviewed, and recommendations for its further development are made.

Manolache (F.) & Tuşa (C.). **Cercetări asupra combaterii omizii capsulelor de bumbac** *Heliothis armigera* **Hb.** (*Chloridea obsoleta* **F.). Notă preliminară.** [Investigations on the Control of the Cotton Bollworm, *H. armigera*. Preliminary Note.]—*Bul. şti. Secţ. Biol.* **8** no. 3 pp. 631–641, 23 refs. Bucharest, 1956. (With Summaries in Russian & French.)

Heliothis armigera (Hb.) is an important pest of cotton and other crops in Rumania, and experiments on its control were carried out in 1953 and 1954 in the regions of Bucharest and Constanza. Dusts were applied at 27–36 lb. and sprays at 80–90 gal. per acre. Experiments against the first generation on chick peas [*Cicer arietinum*] showed that the best results were given by two applications, one at the peak of oviposition (in the second ten days of June) and the other 5–6 days later, when the larvae were hatching, though one sufficed if infestation was light. DDT in a 5 per cent. dust or in a 20 per cent. wettable powder applied at 0·75 per cent. and BHC in a dust containing 2 per cent. γ isomer or a spray containing 0·75 per cent. of a 20 per cent. emulsion concentrate or 2 per cent. of one containing 6 per cent. γ isomer were effective, as also was 0·5 per cent. lead arsenate. Tests against the second and third generations were made on cotton, 1–4 applications being made at similar intervals. The best results were given by 3–4 applications of a dust containing 2·2 per cent. γ BHC or a spray containing 0·75 per cent. of an emulsion concentrate of 20 per cent. γ BHC. Satisfactory increases in yield were obtained.

Manolache (C.), Suta (V.) & Oancea (M.). **Contribuţii la biologia şi combaterea gărgăriţei florilor de măr** (*Anthonomus pomorum* **L.) în Republica Populară Romînă.** [Contributions to the Bionomics and Control of the Apple Blossom Weevil (*A. pomorum*) in Rumania.]—*Bul. şti. Secţ. Biol. (Ser. Zool.)* **9** no. 2 pp. 195–209, 1 col. pl., 2 figs. (1 col.), 46 refs. Bucharest, 1957. (With Summaries in Russian & French.)

Investigations on the distribution, bionomics and control of *Anthonomus pomorum* (L.) on apple in Rumania were begun in 1948. The weevil was found to be common in most of the apple-growing districts, particularly those near forests. The adults overwintered beneath the bark of trees and became active between mid-March and mid-April, after the temperature had averaged 5–6°C. [41–42·8°F.], with a maximum of 10–17°C. [50–62·6°F.], for 8–10 days. They became sexually mature after feeding for 10–12 days and survived for 30–35 days. The eggs were laid mostly in the first ten days of April, in the flowers, and hatched in 6–12 days at average temperatures of 9–20°C. [48·2–68°F.]. The larvae became full-fed in 15–28 days, and 14–36 per cent. of them were parasitised by *Ephialtes* (*Pimpla*) *pomorum* (Ratz.). The pupal stage lasted 8–10 days as a rule, but shorter and longer periods were also observed. The adults emerged mostly in the second and third ten days of May and entered a period of aestivation prior to hibernating. Infestation reached 96 per cent. in some years, and pears were also attacked.

Tests on control were carried out in several different districts and years. Single applications of DDT or BHC sprays when the buds were bursting gave good results in some districts, but two were required in areas with lower temperatures and abundant rainfall. In two localities, the percentage of flowers infested was reduced from 70 or more to 1·2–1·7 by a 25 per cent. DDT emulsion concentrate applied at 0·75 per cent. and the yield increased proportionately.

Manolache (F.), Iacob (N.), Iacob (M.) & Rusu (C.). **Contribuții la combaterea gărgăriței sfeclei** (*Bothynoderes punctiventris* **Germ.**). **(Notă preliminară.)** [Contributions to Control of the Beet Weevil (*Cleonus punctiventris*). Preliminary Note.]—*Comun. Acad. Repub. Pop. Rom.* **7** no. 11 pp. 967–972, 9 refs. Bucharest, 1957. (With Summaries in Russian & French.)

Cleonus (*Bothynoderes*) *punctiventris* (Germ.) is the most injurious pest of beet in Rumania, and tests on its control were carried out in 1956. Dusts of 3 per cent. γ BHC or of 3 per cent. BHC with 5 per cent. DDT at 27–29·7 lb. per acre proved effective, but three applications were required for the best results, one at the beginning of germination, another at its peak and a third 4–5 days later.

Schwenke (W.). **Zur Ernährungsweise der** *Muscina*-**Larven** (**Diptera: Muscidae**). [On the Feeding-habits of *Muscina* Larvae.]—*Beitr. Ent.* **8** no. 1–2 pp. 8–22, 81 refs. Berlin, 1958. (With Summaries in English & Russian.)

During rearing of *Leptinotarsa decemlineata* (Say) in Berlin in 1957, seven males and two females of *Muscina stabulans* (Fall.) emerged on 5th–6th August from puparia formed between two layers of damp filter paper beneath wood-wool in a cage containing dead and living stages of *Leptinotarsa*. The latter represented larvae taken from the field about four weeks previously, many of which had already been removed for test purposes. The wood-wool contained scraps of decaying potato-tops. Although known to feed and oviposit on decaying matter, *M. stabulans* and the allied species, *M. assimilis* (Fall.), *M. pabulorum* (Fall.) and *M. pascuorum* (Mg.), were also believed to develop predaciously or, as was presumed in this instance, parasitically, and rearing on *Leptinotarsa* was therefore attempted.

The adults were confined with 150 larvae of *Leptinotarsa* of various ages in a cage that also contained fresh potato-tops, umbelliferous flowers, sugar and water. Three of the males had died by 14th August, when two instances of pairing were observed, but no oviposition had taken place by 20th August. Decaying potato-tops were then provided, and 45 eggs were collected from them on the following day. The two adult females, each with two males, were confined on 24th August with petri dishes containing healthy pupating larvae and dead, decaying ones, respectively, on filter paper. The female confined with the healthy larvae laid 9 eggs, all on the filter paper, and the other one 37, all on or in the dead larvae, on 26th August. Decaying larvae were added to the dish containing the living ones on that date, and 60 eggs were laid on them on the next day. The larvae had all hatched by 23rd August from the 45 eggs laid in the first test. Those provided with healthy, pupating larvae of *Leptinotarsa* or with fresh potato-tops died within a short time, but others provided with fungus (*Boletus* sp.), larvae or potato-tops, all dead and decaying, completed their development on them. Others given both decaying tops and decaying larvae fed solely on the former. Older larvae of *M. stabulans* fed hitherto on decaying potato-tops were provided with various other food-materials on 30th August. Those given healthy larvae and pupae of *Leptinotarsa*, a pupating larva of *Nymphalis* (*Vanessa*) *io* (L.) or one of *Smerinthus populi* (L.), soon died, and others placed with three healthy, one injured and two dead Noctuid larvae fed only on the dead ones.

The feeding habits of this and the allied species of *Muscina* are reviewed in detail from the literature. It is concluded that records of supposed parasitism by them are unconvincing, particularly since it is not known

whether the larvae were healthy when attacked, and that the species concerned usually complete their development in dead vegetable or animal material. The only exception would seem to be that larvae that have passed the second moult sometimes prey, according to the literature, on certain other Diptera.

Tanasijević (N.). **Zur Morphologie und Biologie des Luzernemarienkäfers *Subcoccinella vigintiquatuorpunctata* L. (Coleoptera: Coccinellidae).** [On the Morphology and Bionomics of *S. vigintiquatuorpunctata.*]—*Beitr. Ent.* **8** no. 1–2 pp. 23–78, 28 figs., 41 refs. Berlin, 1958. (With Summaries in English & Russian.)

Subcoccinella vigintiquatuorpunctata (L.) is an important pest of lucerne in Yugoslavia, and detailed investigations on its bionomics were carried out, mainly in Serbia, in 1950–55. All stages of the Coccinellid and the anatomy of the male and female genitalia are described, and the structure of the alimentary canal is compared with that of a purely predacious species. Lists are given of its known food-plants and of others on which it was induced to spend part or the whole of its life-cycle.

There were two generations a year, the adults overwintering mainly at the base of the lucerne stems or among adjacent plant remains, but some doing so in sheltered positions in neighbouring woods or other places. They resumed activity at a minimum temperature of 8°C. [46°F.] and left their winter quarters on 18th–26th March in lucerne fields near Belgrade. The females oviposited, usually from the beginning of April to mid-May, and the eggs were laid mainly on the lower, but also on the upper, surfaces of the leaves, and rarely on the stems. Mowing of lucerne fields in spring, with the resulting higher temperatures, lower humidity and shortage of food, greatly reduced fecundity. The larvae fed almost exclusively on the leaves, becoming full-fed from the middle or end of May if the weather was warm, and all stages of the Coccinellid were present by the end of the month. First-generation adults emerged from 30th May to 26th June, fed voraciously and oviposited mainly from 10th–20th June to the beginning of July. Second-generation larvae were present in about the last third of June and in July. Mowing of the lucerne fields in summer caused concentrations of the adults and larvae in neighbouring positions, but also caused mortality of adults and, in particular, of eggs, as well as sterility of the females. Pupation began in the last ten days of July, and adults appeared 7–12 days later. Most of the adults of the first generation died in July but a few were observed in diapause in the dried foliage of trees or beneath burst bark scales near lucerne fields. Some of the second-generation adults entered diapause at the base of lucerne plants immediately after emerging; the rest paired, fed for a while and then entered a resting period on the plants, feeding occasionally and gradually becoming sexually mature. The second-generation adults entered their winter quarters usually in October.

On lucerne in the laboratory, at a relative humidity of 70–80 per cent., the periods required for the egg and larval stages ranged from 18·6 and 43 days, respectively, at 14°C. [57·2°F.] to 4·5 and 12·2 days, respectively, at 32°C. [89·6°F.], and those for the prepupal and pupal stages from 6 and 13·5 days at 14°C. to 2 and 3 days at 28°C. [82·4°F.]. Females tended to be slightly more numerous than males in both generations, and the numbers of eggs laid by first-generation females (about 200–300) were generally somewhat higher than those laid by overwintered females. The only parasite observed was *Tetrastichus epilachnae* (Giard), which was of most importance during the second generation; 5·5–36·3 per cent. of the larvae were parasitised by it.

Drees (H.) & Schwitulla (H.). **Untersuchungen über die Parasitierung von** *Arctia caja* **L. durch** *Apanteles cajae* **Mg.** [Investigations on the Parasitism of *Arctia caja* by *Apanteles cajae*.]—*Pflanzenschutzberichte* **18** pt. 1–2 pp. 1–12, 2 figs., 12 refs. Vienna, 1957. (With a Summary in English.)

Arctia caja (L.), which is polyphagous but only occasionally injurious, was numerous in 1950 in an uncultivated plot consisting mainly of fruit trees and bushes near Cologne [*cf. R.A.E.*, A **46** 2], and damage by it became noticeable in the following year. Small, isolated foci of its parasite, *Apanteles cajae* (Bch.), were present in 1950, and investigations on the effectiveness of this Braconid were carried out. There was only one generation of *Arctia* a year. The adults emerged in May, oviposition began soon after pairing, and the larvae hatched in about six days, attacked various low-growing plants and entered hibernation, usually in September. In spring, they resumed feeding and caused considerable damage to gooseberry, currant and rhubarb and, after reaching the third instar, to the leaves of plum, apple and pear and the young fruits of the last two. They pupated in April on the surface of the soil or between leaves, and the pupal stage lasted about four weeks. Adults of *Apanteles* emerged about the beginning of May. The females oviposited in the newly hatched *Arctia* larvae after about a month, and the parasite larvae remained in their hosts throughout the winter, leaving them in spring to spin cocoons on leaves or branches. The pupal stage averaged eight days. The number of parasite larvae per host ranged from 3 to 31. Host larvae from which at least 13 emerged invariably died, but some of those parasitised by fewer were able to pupate, though the pupae were mostly deformed and the few adults that emerged abnormal.

The work with the parasite was begun in 1950, when 39 *Arctia* larvae bearing *Apanteles* eggs were taken to the laboratory; 653 *Apanteles* larvae emerged in 1951, and the resulting adults were caged in groups of 16 with *Arctia* larvae at 40 sites in the plot. Of the 390 *Arctia* larvae present, 144 were parasitised, and 2,299 *Apanteles* cocoons were obtained. Parasitism by *Apanteles* in the rest of the plot was only about 10 per cent. In 1952, when the *Arctia* population had fallen to about 30 per cent. of that of the previous year, batches of 40 parasite adults were liberated at 20 points throughout the plot in places where newly hatched *Arctia* larvae were abundant. Of 408 of the latter, 200 were parasitised, and 3,716 *Apanteles* cocoons were present in 1953. In the following generation, however, only 37 of the 96 *Arctia* larvae present in the foci were parasitised, and only 714 cocoons of *Apanteles* resulted. A fall in the host population was thus followed by a reduction in the percentage parasitism. In positions adjoining the release sites, the percentage parasitism was 39 and 38, respectively, in 1952 and 1953, from which it is concluded that the parasite spread but little. In a laboratory test in which 350 *Apanteles* adults were confined with 220 *Arctia* larvae, and in other, similar tests, the percentage parasitism remained at about 80.

Dosse (G.). **Die ersten Funde von** *Brevipalpus inornatus* **Banks (Acar., Phytoptipalpidae) in europäischen Gewächshäusern.** [The first Finds of *B. inornatus* in European Glasshouses.]—*Pflanzenschutzberichte* **18** pt. 1–2 pp. 13–17, 3 figs., 3 refs. Vienna, 1957. (With a Summary in English.)

Brevipalpus inornatus (Banks), which is widely distributed on ornamental plants, particularly those in glasshouses, in the United States, was not known to occur in Europe until it was found some years ago on lemon

imported into the United States from Italy. It was recently observed almost simultaneously in glasshouses in widely separated parts of Europe, where it appears to be increasing in numbers. It occurred on azalea at Vienna, on *Aralia* and *Cissus* at Hamburg, on *Campanula* near Mainz, on ivy at Heidelberg and Stuttgart, and on *Gardenia* at te Lent, in Holland. The only males found comprised three from Vienna. Characters are given distinguishing the adult females and the deutonymphs from those of other species of the genus. Mites reared in the laboratory on ivy at Stuttgart reproduced parthenogenetically through four generations. At room temperatures of 18–21°C. [64·4–69·8°F.], they laid a maximum of 21 eggs each, on the lower surfaces of the leaves, the preoviposition period lasted 3–11 days, with an average of 6·5, and the egg, larval, protonymphal and deutonymphal stages averaged 11·8, 6·3, 6·2 and 6·5 days, respectively [*cf. R.A.E.*, A **43** 209].

Böhm (O.). **Ein seltenes Schadensbild der Blumenkohlminierfliege** (*Phytomyza rufipes* **Mg.) an Kohlgewächsen.** [A rare Type of Injury to Crucifers by *P. rufipes.*]—*Pflanzenschutzberichte* **18** pt. 1–2 pp. 18–21, 2 figs., 7 refs. Vienna, 1957. (With a Summary in English.)

Phytomyza rufipes Mg., which was not previously known as a pest in Austria, was observed in Vienna in March 1956 causing damage of an unusual type to cruciferous vegetables growing in a greenhouse. Injury by this Agromyzid is usually due to mining of the stalks by the larvae, but in this case the adult females punctured the edges of the leaves with their ovipositors and fed on the sap, causing the formation of gall-like swellings on the lower surfaces. Kohlrabi received the most damage, cabbage appreciably less and cauliflower very little. This unusual behaviour of the adults is ascribed to the absence of their usual food. No further damage occurred after the plants had been sprayed with parathion, and, though eggs were present, very few larvae appeared on a few plants kept for observation. The infestation is thought to have been introduced into the greenhouse with soil.

Kudela (M.). **Hubení ploskohřbetky smrkové** (*Cephaleia abietis* **L.) insekticidy ve vztahu k jejím přirozeným nepřátelům.** [The chemical Control of *Cephalcia abietis* and its natural Enemies.]—*Práce Výzkum. Ústavů lesn. ČSR* **12** pp. 191–247, 21 figs., 42 refs. Prague, 1957. (With Summaries in Russian & German.)

The following is based on the author's summary. Serious damage to spruce by *Cephalcia abietis* (L.) has occurred in many parts of the Erzgebirge, on the northern frontier of Czechoslovakia, since 1948, and investigations on its natural enemies and control were carried out near Oberleutensdorf in 1953–56. Adult flight and oviposition in the needles was at a maximum about mid-June and lasted a considerable time. The full-fed larvae left the needles and entered the soil, and 9–38 per cent. of the adults emerged in the following year and the rest in the next but one.

Adult females were preyed upon by *Formica rufa* L., *Camponotus herculeanus* (L.) and spiders, and these together caused 8–13 per cent. mortality in 1955. Oviposition was very dependent on weather, and in June 1956, which was cold and wet, the females laid only 23 eggs each, one-third of the total contained in the ovarioles. Eggs were eaten by larvae of *Raphidia ophiopsis* L., *Anatis ocellata* (L.), *Adalia* (*Coccinella*) *bipunctata* (L.) and *A.* (*C.*) *decempunctata* (L.) and parasitised by *Trichogramma* sp., parasitism by which amounted to 15–25 per cent. in 1954 and up to 90 per cent. in 1955. Larvae feeding in the crowns of the trees were parasitised

by *Nehomaspis narrator* (Grav.), *Xaniopelma sericans* Tschek, *Xenoschesis fulvipes* (Grav.), *Apechthis resinator* (Thnb.) and *Zenillia* (*Exorista*) *hortulana* (Mg.), all of which emerged about the beginning of July, and by *Homaspis robustus* (Thoms.), which was in some places the most numerous larval parasite in 1954, and the rather rare *Diplazon ornatus* (Grav.), both of which emerged between mid-July and August. All required one year for development. The larvae in the soil were parasitised by a species of *Campoplex* (*Eulimneria*) near *C.* (*E.*) *nitidus* Brischke, which was the most numerous of all the parasites. It emerged in mid-June, and parasitism by it averaged 15–30 per cent., ranging up to 70 per cent. in some places in the autumn of 1955. Up to 59 per cent. of all the larvae found in the soil between September 1954 and June 1956 were found to have been destroyed by parasites, with a maximum of 62 per cent. in the autumn of 1955. Many living larvae and adults were found to contain capsules representing the remains of eggs and larvae of parasites. Females containing these, which represented 35 per cent. of all females in 1954 and up to 80 per cent. in 1955, developed more slowly than normal ones and laid only 47 per cent. as many eggs. Larvae in the soil were further attacked by larvae of *Thereva nobilitata* (F.), which also destroyed the parasites in them, and by fungi, viruses and bacteria. Fungi became numerous only following prolonged rain in the summer of 1954, but the last two destroyed 42–74 per cent. of the larvae in shallow soil and 16–43 per cent. of those in deeper soil between September 1954 and June 1956. Total mortality of larvae in the soil during this period reached 75–92 per cent. The diseases also killed the parasites, and, in 1954, destroyed 64 per cent. of the pupae of *H. robustus* and *X. fulvipes*, as compared with only 24 per cent. of the larvae of *Cephalcia abietis*.

In the control tests, a dust containing 8 per cent. BHC applied at the beginning of adult flight at about 12·6 lb. per acre gave 81–90 per cent. mortality of adult females in 24 hours but only 23–76 per cent. mortality of all emerging females, and it is considered that two applications, the first after 25–33 per cent. of the females have emerged and the second three days later, would be more effective. The same dust applied against the larvae in the trees at about 40 lb. per acre gave 10–22 per cent. mortality, mainly of first- and second-instar individuals, but destroyed up to 60 per cent. of the adult parasites, and parasitism in treated stands fell to as little as 7 per cent., as compared with 11–24 per cent. in untreated ones.

Münster (J.) & Joseph (E.). *Rhopalosiphoninus staphyleae* **subspec.** *tulipaellus* **Theob. 1916, le puceron des silos de betteraves.**—*Landw. Jb. Schweiz* **72** pt. 4 pp. 457–459, 1 fig., 3 refs. Berne, 1958. (With Summaries in German, English & Italian.)

The spread of beet yellows has increased in French Switzerland in recent years. During investigations on several possible plant reservoirs of the virus, alates, apterae and nymphs of *Rhopalosiphoninus staphyleae* subsp. *tulipaellus* (Theo.) were observed in May 1957 at Rovray, Vaud, on the etiolated shoots of beets left in the field after the opening of a clamp a few weeks previously. This appears to be the first record of the aphid in Switzerland. It was present in large numbers, although the temperature had fallen to −7°C. [19·4°F.] a few days earlier; exposure of the beets to light caused the aphids to seek shaded shoots on them. It is a vector of the yellows virus, and, though not known to occur on beet in summer, it disseminates the virus among beets stored in clamps or buildings and thus facilitates its spread from them in spring by *Myzus persicae* (Sulz.), if this is also present. The two do not differ much in vector ability.

Williams (J. R.). **Cane Pests.**—*Rep. Mauritius Sug. Ind. Res. Inst. 1957* pp. 66–71, 2 figs., 3 refs. Réduit [1958].

Experiments on the value of soil insecticides for the control of larvae of *Clemora smithi* (Arr.) attacking the roots of sugar-cane in Mauritius were begun in 1954. The insecticides were applied to the soil in emulsion form at about 400 and later 200 gal. per acre, and a watering-can proved the most suitable means. The results are given in tables showing the numbers of larvae found after treatment as percentages of those in untreated plots. In tests in which chlordane was applied to the furrows before planting in November 1954 at about 3 and 6 lb. per acre, these percentages were only 25 and 8, respectively, in 1955, 43 and 19 in 1956 and 48 and 39 in 1957. In 1955, chlordane at about 4 lb. per acre was applied to the furrows before planting in August or to the rows after germination in November, and the percentages in 1956 and 1957 were only 9 and 13 per cent. for the first method and 25 and 26 per cent. for the second. Application of about 4, 6 and 8 lb. chlordane per acre to the rows shortly after germination in March 1956 led to percentages of 32, 17 and 13 in 1957. The percentages in 1957 were 10 and 4 for chlordane at 4 and 8 lb. and 17 and 4 for aldrin at 2 and 4 lb. per acre, applied to the furrows before planting in May 1956, and 0 and 14 for 2 and 4 lb. chlordane and 0 for 2 or 4 lb. aldrin per acre similarly applied in August 1956. When the insecticides were applied to the rows of ratoon cane after harvest, the percentages in the following year were 60 and 41 for 3 and 6 lb. chlordane per acre applied in November 1954, 41 and 37 for 2 and 4 lb. chlordane and 29 and 17 for 2 and 4 lb. aldrin per acre, applied in November 1956, and 44 for 2 or 4 lb. chlordane and 32 for 2 or 4 lb. aldrin per acre applied in September 1956. There were no significant effects on cane yield, but infestation was low in almost all the tests. It is concluded that both chlordane and aldrin offer considerable promise and that the effects of chlordane are prolonged. The persistence of aldrin remains to be tested.

In view of the establishment of Fiji disease of sugar-cane on the east coast of Madagascar [*cf. R.A.E.*, A **45** 171–172], attention was paid to the natural enemies of *Perkinsiella saccharicida* Kirk., the vector of the virus [*cf.* **46** 371]. *Tytthus mundulus* (Bredd.), which preys on the eggs of the Delphacid, was introduced into Mauritius in 1956–57. Several consignments of eggs were despatched from Hawaii. Most of these hatched in transit, and about 24,000 nymphs of the Mirid were released in different parts of Mauritius. Most of the colonies died out, but establishment resulted at one locality in Flacq, where 15,000 had been released, and it is expected that dispersion to other localities will occur.

Papers noticed by Title only.

Zimmerman (E. C.). **Insects of Hawaii. A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc. Volume 8. Lepidoptera: Pyraloidea.**—ix [+3+] 456 pp., 350 figs., 30½ pp. refs. Honolulu, Univ. Hawaii Press, 1958. Price $8.00. [*Cf. R.A.E.*, A **47** 76, etc.]

Steinhaus (E. A.). **Microbial Diseases of Insects** [a review of recent literature].—*Ann. Rev. Microbiol.* **11** pp. 165–182, 4½ pp. refs. Palo Alto, Cal., 1957.

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INDEX OF AUTHORS

ANON., 176, 189.

Banaag, A. F., 181.
Barrett, J. H., 182.
Barrie, J. W., 181.
Barthel, W. F., 184.
Bhambhani, H. J., 178.
Blakeley, P. E., 186.
Blinn, R. C., 184.
Böhm, O., 194.
Bradley, J. D., 163.
Briggs, J. B., 167.
Brown, E. S., 168.
Brumbaugh, J. H., 183.
Bunday, G., 160.
Bünzli, G. H., 167.
Butani, D. K., 179.
Büttiker, W. W., 167.

Cannon, F. M., 187.
Channa Basavanna, G. P., 179, 180.
Chant, S. R., 173.
Coppel, H. C., 176.

David, W. A. L., 164.
Davies, M., 182.
Dippenaar, B. J., 175.
Dosse, G., 193.
Drees, H., 193.
Dürr, H. J. R., 175.

Elmer, H. S., 184.
England, D. C., 183.
Ewart, W. H., 184.

Gardiner, B. O. C., 164.
Gay, F. J., 158.
Gershenzon, S., 188.
Gertler, S. I., 184.
Ghesquière, J., 176.
Gunther, F. A., 184.

Hanna, A. D., 171.
Harrow, K. M., 158.
Heatherington, W., 171.
Henderson, M., 180.
Hoy, J. M., 182.
Hussey, N. W., 174.

Iacob, M., 191.
Iacob, N., 191.

Jacobson, L. A., 186.
Joseph, E., 195.
Joubert, C. J., 175.

Kasting, R., 187.
Katarki, H. V., 176.
Kiigemagi, U., 183, 184.
Kudela, M., 194.

Lea, A., 174.
Lee, P. E., 188.
Leius, K., 176.
Longair, E. L., 187.
Lubatti, O. F., 160.
Luis, R. A., 181.

MacCuaig, R. D., 159.
McGinnis, A. J., 187.
MacLeod, J., 162.
Manolache, C., 190.
Manolache, F., 190, 191.
Mapother, H. R., 171.
Milne, A., 165.
Mitchell, W. C., 184.
Mohammad Ali, S., 178.
Münster, J., 195.
Murthy, D. V., 179.

Nair, M. R. G. K., 177.
Narayanan, E. S., 178.
Nye, I. W. B., 166.

Oancea, M., 190.
Olenov, Yu. M., 188.

Parkin, E. A., 161.
Parr, W. J., 174.
Patel, G. A., 176.
Patel, N. G., 176.
Puttarudriah, M., 179, 180.

Raw, F., 163.
Read, D. C., 187.
Robinson, A. G., 188.
Rusu, C., 191.

Schwenke, W., 191.
Schwitulla, H., 193.
Smith, K. M., 158.
Sprowls, R. G., 184.
Stallard, D. E., 183.
Steiner, L. F., 184.
Steinhaus, E. A., 196.
Stephen, W. P., 176.
Struble, G. R., 185.
Subramanian, T. R., 177.
Suta, V., 190.
Swaine, G., 170.
Szent-Ivany, J. J. H., 182.

Tanasijević, N., 192.
Telford, A. D., 185.
Terriere, L. C., 183, 184.
Thresh, J. M., 172.
Tuşa, C., 190.

Usman, S., 179.

Vanderplank, F. L., 169.
Van Middelem, C. H., 185.
Viado, G. B., 181.

Wacker, G. B., 184.
Waites, R. E., 185.
Walters, S. S., 175.
Wetherly, A. H., 158.
Wickens, R., 171.
Williams, J. R., 196.
Williams, R. C., 158.

Zimmerman, E. C., 196.

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CONTENTS.

		PAGE
EDITORIAL:	The late Sir Guy Marshall	157
AFRICA:	Rearing and Control of Cacao Mirids in Ghana	163
AFRICA:	Fungus Diseases of Lamellicorn Larvae in S. Rhodesia	167
AFRICA:	Injuriousness and Control of *Pseudotheraptus wayi* in Zanzibar ...	169
AFRICA:	*Helopeltis* spp. damaging Cashew in Tanganyika	170
AFRICA:	Dimefox Trunk Treatment against Cacao Mealybugs in Ghana ...	171
AFRICA:	Spread of Cacao Swollen-shoot in Ghana and Nigeria	172
AFRICA:	Transmission of Cassava Mosaic by *Bemisia tabaci* in Nigeria ...	173
AFRICA:	Outbreaks of *Locustana pardalina* and Rainfall	174

[*Continued on p. iv of cover*

CONTENTS—*cont.*

PAGE

AFRICA: Soil Insecticides against *Iridomyrmex humilis* in Cape Province 175
AFRICA: *Calacarus citrifolii* in the Transvaal and its Control 175
AFRICA: An Egg parasite of *Trioza erytreae* in Belgian Congo 176
AUSTRALIA: The Protection of Timber and Hardboard from Termites ... 158
AUSTRIA: Unusual Injury to Crucifers by *Phytomyza rufipes* 194
BRITAIN: The Sex Ratio in *Anomala horticola* 165
BRITAIN: Studies on Diptera infesting Grasses and Cereals 166
BRITAIN: Strains of *Amphorophora rubi* on Raspberry 167
BRITAIN: Occurrence of two Forms of *Tetranychus telarius* 174
BRITAIN: Pyrethrum protecting Bacon from Blowflies 182
CANADA: Climatic Factors affecting Hatching of *Agrotis orthogonia* ... 186
CANADA: *Hylemyia brassicae* injuring Swedes in Prince Edward Island ... 187
CANADA: Control of *Hylemyia brassicae* in Prince Edward Island 187
CANADA: Stem Composition and Resistance to *Cephus cinctus* in Wheat ... 187
CANADA: *Macrosteles fascifrons* and Aster Yellows in Manitoba 188
CZECHOSLOVAKIA: Insecticides and Natural Control of *Cephalcia abietis* ... 194
EUROPE: First Records of *Brevipalpus inornatus* in Glasshouses 193
GERMANY: The Feeding Habits of *Muscina stubulans* 191
GERMANY: Investigations on Parasitism of *Arctia caja* by *Apanteles cajae* 193
HAWAII: A Volume on the Pyraloidea (*Title only*) 196
INDIA: Insecticides against *Empoasca devastans* on Cotton 176
INDIA: The Life-history of *Paramecops farinosa* 177
INDIA: The Bionomics of *Nipaecoccus vastator* on *Citrus* 178
INDIA: A Test of Fumigation at reduced Pressure 178
INDIA: The Parasites of *Chilo zonellus* in Bombay State 179
INDIA: An Outbreak of *Pseudaletia unipuncta* on Sugar-cane 179
INDIA: A Tachinid parasitising *Adisura atkinsoni* 179
INDIA: The Bionomics of *Pachydiplosis oryzae* 179
INDIA: Insect Predators of Aphids and Mites in Mysore 180
MALAYA: *Deloryctis corticivora* attacking Rubber Trees 163
MALAYA: Insecticidal Control of *Plutella maculipennis* 180
MAURITIUS: Pests of Sugar-cane and their Control 196
NEW GUINEA: Insect Pests of Coffee 181
NEW GUINEA: Insects attacking Banana 182
NEW ZEALAND: Coccids associated with *Metrosideros* and *Weinmannia* ... 182
PHILIPPINES: Sprays against Lepidoptera on Maize 181
RUMANIA: Tests on the Control of *Heliothis armigera* 190
RUMANIA: The Bionomics and Control of *Anthonomus pomorum* 190
RUMANIA: Insecticides against *Cleonus punctiventris* on Beet 191
SOLOMON IS.: Ants in Relation to *Amblypelta* spp. on Coconut 168
SWITZERLAND: *Rhopalosiphoninus staphyleae tulipaellus* on Beets in a Clamp 195
U.S.S.R.: A Polyhedral Virus of *Galleria mellonella* 188
U.S.A.: Persistence of Diazinon Residues on *Citrus* Fruits 184
U.S.A.: Investigation of new Attractants for *Ceratitis capitata* 184
U.S.A.: Demeton Residues on leafy Vegetables 185
U.S.A.: Insects associated with Cotton in Arizona 185
U.S.A.: *Scolytus ventralis* and its Importance in Forests 185
WEST INDIES: Dissemination of Cacao Swollen-shoot in Trinidad 172
YUGOSLAVIA: The Life-history of *Subcoccinella vigintiquatuorpunctata* on Lucerne 192
Two Viruses of *Tipula paludosa* 158
The Toxicity of Insecticides to Locusts 159
Studies on the Fumigation of Potatoes with Methyl Bromide 160
The Value of Malathion against Stored-product Pests 161
Estimation of Numbers of Insects from low-incidence Recapture Data ... 162
Evaluation of Fluoroacetamide as a Systemic Insecticide 164
Tenth International Congress of Entomology: Section on Systematics ... 176
Morphological Variations in Populations of *Pristiphora erichsonii* 176
Haemolymph Proteins and their Use in taxonomic Studies 176
Epicuticular Structure and Action of inert Dusts on Insects 177
A Comparison of Spray Deposits on Cacao 180
Determination of Residues of Tetrachloroethylene in fumigated Wheat ... 183
Endrin Residues in the Meat and Milk of Farm Animals 183, 184
Selection increasing Resistance to DDT in *Drosophila* 188
A Conference on Cereal Bugs 189
Microbial Diseases of Insects (*Title only*) 196

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